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Engineering News-Record

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Mixing Concrete at a Central Plant for Distribution on Road Work

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Will It Be War?

LET us not disguise the fact that if the railroad workers tie up the country Oct. 30, it will be WAR—not the war of powder and shot, but a rebellion in which one section of the community will claim the right to deprive the rest of us of food and fuel and work. That is war. It is stoppage of the blood stream of the nation. If the men will not listen to reason, if they refuse to accept the working of the machinery provided by law, by the Transportation Act, there can be only one answer—the country will have to commandeer every able-bodied man who believes in law and order, and then, painfully and slowly, while the highways function as an emergency measure, get the railroads back to work with new forces. Any group that conspires against the whole public must be taught that it cannot prevail.

The Club Will Not Do

THERE is some feeling that the brotherhoods are using the strike call as a club; if they fail to secure a modification of the 12-per cent reduction ordered by the War Labor Board, they will recall the strike order and find some way of saving their faces. There is no value on speculating on this surmise. It is worth recalling, though, that they have precedent in expecting good results from using the nation-wide strike threat. They used it in 1916—and won. Supported by President Wilson, they forced from Congress the 8-hr.-work-for-10-hr.-pay Adamson law, with its inherent overtime abuses. A country on the verge of war, a country more sympathetic to the demands of labor then than now, allowed the President to put the law through. If we are correct in our view, often expressed in these columns, that labor's excesses during and since the war have lost for it the sympathies of millions, the public will not again—at least, not now—sanction an abject capitulation to the brotherhoods. The club of 1916 has, under the withering sun of public distrust, dwindled into a reed.

Wrong Time To Strike

THERE are other reasons, other than the heavy loss in sympathy, why public disapproval of the threatening walkout is to be expected. Wages and salaries everywhere are on the down grade. The public, while accepting reductions, will not be tolerant of those who cripple the country in order to maintain their own wages. Secondly, the strike is not against the carriers, but against the government, against the decision of the War Labor Board, which was established by Congress—by the very Congress which the brotherhoods and the President clubbed into giving them the silver-lined Adamson law. They love Congress on the way up, but reject it on the way down. Finally, in a time of unemployment, aye, in the very week in which the government has terminated a conference that has made unemployment relief dramatic, the railroad workers not only decide to increase the unemployed ranks by quitting work themselves, but complacently proceed to throw out hundreds of thousands of others through the inevitable consequent stoppage in mines and factories. In the wake of a railroad stoppage, too, must follow further distress through the rise of food and fuel prices, adding so much more to the burden of the unemployed. Surely, this is no time to strike. Conditions at the present have stacked the cards against the brotherhoods. They are sure to fail.

Meeting the Crisis

AS WAS to be expected, plans are already under way for meeting the strike. It is apparent that outsiders will have to be impressed, at least temporarily, into railroad service, and that the highways will have to be used to the utmost until the railroad wheels are again moving normally. The highways and the motor truck saved the situation during the English railway strike. They will be almost as effective here, though, obviously, in our stretched-out West and South, their service cannot be as helpful as in compact England and in our own thickly settled East. Of volunteers for any work there will be no shortage. We will do as well in this respect as England did. No class there was found wanting—the essential requirement is effective organization. Men and highway transport will not be found wanting.

Railway Obstacles to City Growth

CONTROVERSY over track arrangements has arisen in many cities as a result of permission or encouragement given the railways in earlier days to lay their lines where and how they pleased, the municipal authorities acting without due consideration for the city's probable future growth. Aggravated cases occur in streets as well as on private right of way. The problem of securing removal of tracks or abandonment of right of way within city limits is a problem distinct from, but frequently related to, that of separation of grades in order to eliminate street crossings at grade. In "city planning" projects such difficulties are frequently encountered. For this reason it is of interest to record the successful inauguration at Dallas, Tex., of a policy for clearing the streets of railway tracks and also improving the facilities for both street and railway traffic. In that city, the usual haphazard development of trackage by several railways during a term of years has cut up the business section and hampered its growth seriously, main lines and sidings having been laid in some of the streets. As the occupancy was covered by franchises it was not easy to get the tracks removed. Co-operation rather than coercion has been the principle of action. Recognizing the rights of the railways, a site for a new industrial district adjacent

to the business section was secured, rights-of-way on this being offered to the railways in exchange for their abandonment of certain lines. This offer has been accepted by one road and is under consideration by others. Undoubtedly the results will be of mutual benefit to the railways, the business interests and the public. Utilization of abandoned railway rights-of-way for new streets and boulevards is an unusual and particularly interesting phase of the improved project.

Imhoff Tanks at Baltimore

SWEEPING conclusions against Imhoff tanks should not be drawn from the fact that Baltimore has returned to primary settling and separate sludge digestion tanks for extensions to its sewage-works after trying both kinds alongside. The entire record should be studied to learn how far local conditions militated against Imhoff tanks at Baltimore and to what extent the same general conditions are likely to prevail at any other place where Imhoff tanks are under consideration. These remarks are prompted by the article on extensions to the Baltimore sewage-works, in this issue, and the much more detailed article on nine-years' operating results in our issue of July 14, p. 50. There should also be considered an article entitled "The Truth About Imhoff Sewage Tanks at Baltimore," in our issue of July 11, 1918, p. 84, and resulting correspondence, Aug. 22, 1918, p. 374. These three articles, by as many men with intimate knowledge of the subject, leave no doubt as to the conviction of their authors that primary settling and separate sludge digestion tanks are better than Imhoff tanks for Baltimore conditions. The Baltimore experiences while adding to the growing body of testimony against Imhoff tanks, should be studied in detail before being made the basis for sweeping generalizations.

Doubting Thomases Satisfied

THERE were many doubting Thomases when the President's Unemployment Conference was announced. Previous general conferences had come to naught, therefore, little was expected from this one. The results, however, are encouraging. One cannot record now a definite lessening of unemployment due to the conference, but it is of record that within one week of the passing of the recommendations regarding emergency relief thirty-one cities had organized suitable committees; this number has by now been much increased. The conference has definitely succeeded in throwing back on the local communities a problem that is properly theirs, but which some wanted to pass on to the federal government, and others were neglecting out of ignorance of its seriousness and of effective methods of attack. On the functioning of the local committees, of course, depends the results, but here, again, the conference has done what it could by erecting an activating and stimulating agency in the Department of Commerce. The doubting Thomases are being well satisfied regarding the Unemployment Conference.

In a Spirit of Good Will

SECRETARY HOOVER, in closing the unemployment conference, gave voice to a thought that is worth passing along—that this was the first time, except under war pressure, that extremes of social thought had been brought together under government supervision, and had departed in a spirit of good will. Disagreements in detail there necessarily were, while from one of the committees majority and minority reports, not acted on by the conference, were received. But in the sincere search for fundamentals, the controversial points were, as a rule, put aside. As a result, there was agreement on views that make a worth-while contribution to the solution of the problem in hand. It is an instance of what can be done under tactful, purposeful, and broad leadership—a leadership in this instance furnished by Mr. Hoover.

Lessons in a Penstock Break

THE interest that naturally attaches to any failure in engineering work because of the opportunity of learning something therefrom is increased in the case of the accident to the Big Creek No. 8 penstock because hammer-welded pipe is in use under high heads in many other western plants. If there had been foundation for the early rumors that a joint in the welded pipe had failed, it would have engendered apprehension concerning all welded high-head pipe now in service. Fortunately the accident constitutes a testimonial to the strength of welded pipe, as the steel plate of the penstock shell tore parallel to and across welds without developing any weakness in them. The defective spot where the break is believed to have started is found to have been an interior flaw in a steel casting used as a manhole frame, and not a welding fault.

In the light of this incident it is safe to say that steel castings, because of the dangers of hidden defects to which they are subject, are now a thing of the past in high-head penstocks except where they can be used with a safety factor sufficient to make the unit stresses very low. Where the size and shape of the special work make it feasible to use steel forgings, these will doubtless be standard practice henceforth.

The entry of the human element unfortunately does not permit of equal assurance that other causes, which were more or less important factors in the accident, will not be repeated. There is every indication that this was a clear-cut case of being in too much of a hurry to finish the job. The development was rushed at highest possible speed from the outset. Under such conditions even in the best organizations there is danger of overlooking things essential to safe operation. If the rush had ended when the time for testing-out came, everything might have been well. Good practice in plants where long penstocks and high heads are used calls for tests, inspections and adjustments; they take time, but they are as important as the selection of proper materials or correct design. For example, in testing out such a plant it is advisable to begin with the opening stroke of the governor set slow enough to eliminate any danger of breaking the water column. Western conditions call for unusually slow governor opening—as much as 45 or 60 seconds is advisable under the characteristics of some plants. By placing pressure gages at various points along the pipe line and carefully studying the characteristics it is possible to adjust the governor so the hydraulic gradient will never be likely to approach the danger point.

The Big Creek No. 8 plant had just been put on governor control at the time of the accident, but no official statement has been made as to what governor setting was used. The conditions stated in the article in this issue lead to the conclusion that the gates were opened

quickly and then suddenly closed. If the opening stroke of the governor was as rapid as 3 or 4 seconds, for example, there would be grave danger, on such a plant as this, of a pressure rise in the penstock amounting to perhaps several hundred per cent and this would endanger even a pipe line in perfect condition.

As to the conditions at the upper end of the penstock, it is only necessary to call attention to the fact that, as operated at the time of the accident, a long penstock 8 ft. in diameter at the top was served by a temporary connection 6 ft. in diameter and with only a 6-in. air vent. The 6-ft. pipe was supplied by a long tunnel driven with not much more slope than the hydraulic gradient. This constitutes a hydraulic combination which, in the event of any rapid velocity in the penstock, would permit the hydraulic grade line to drop to a point where a break in the water column might occur.

To summarize: First, adequate time must be allowed for testing out and adjusting automatic control features of a high-head plant before they can be expected to function properly. Second, steel castings should not be used where the cost of forgings is within reason, or, where the former are used, the unit stress should be kept low. Third, adequate surge chamber and air vent provisions constitute a penstock protection when other safeguards fail and should never be neglected.

New Developments in Impact

SOME of the most troublesome problems in engineering must be attacked by mass experimentation. Bridge impact is a problem of this kind, and the English tests reported in some detail on another page represent mass experimentation of prime character. They come as a most pleasant surprise in a field where experimental study has been dormant for a long time. Moreover, furnishing almost the sole data on the subject we possess outside the tests conducted by Prof. Turneaure for the American Railway Engineering Association, they have great weight and merit the most careful study.

Taking a broad survey of the work, as the easiest way to become oriented in a large mass of facts, it will appear from the summary sheets that the numerical results of the new tests are quite as erratically scattered as those heretofore obtained. Erratic results, however, are not a satisfactory basis for the development of laws or of safe working rules, until a sufficient number of data has been accumulated to define the range of variation fairly definitely. A glance at the composite plot of the results compared with those of the A. R. E. A., reproduced directly from Maj. Mount's report, suggests at once that in spite of the great number of tests conducted by his committee, their principal effect is to point out the need for further experimentation.

In this particular field—a remarkably complex one—much depends on primary conceptions. What does the term impact mean? In substance, we may say, it implies weighing the traffic service of a bridge in pounds: estimating the effect of moving trains in terms of dead weight. Such weighing is an obvious prerequisite to the possibility of proportioning railway bridges with proper regard for the relation of strength of materials to service. Major Mount goes more directly to the point in this respect than some prior writers, by defining impact as "the effect produced upon any member of a structure by a moving load which results in stress exceeding the static stress." He might as well have written the last words "ideal static stress," since, in actual practice, comparisons between live-load effect and calculation are made on this basis. The elementary calculations of bridge stress are, as a matter of fact, made without regard to such practical factors as stiff joints, or crookedness or eccentricity of members—secondary actions, so called. But it is not certain that all engineers will be prepared to accept Mount's definition. It would mean much for progress if agreement could be reached on these fundamental conceptions.

Special value attaches to the Ministry of Transport measurements on account of the instrument used. It is the first photo-recording extensometer applied to this class of testing, so far as we know, and the results of its working are instructive despite what the report says about deficiencies of the device. The extensometer apparently proved itself highly sensitive and free from inertia.

For this very reason it is the more significant that the final results are erratic. The fact seems to prove what many have heretofore suspected, namely that the phenomena of impact are essentially complex and erratic, being not a single action but the chance sum of several chance effects. If this is the case, however, no refined formula to express impact values for purposes of bridge design is worth while, or, for that matter, is possible.

One of the special features of the Mount tests is that very short spans were tested. The results with these supplement prior data in an essential way—perhaps not so much in their bearing on the proper impact formula as in their applicability to the proportioning of such details as flange rivets and connections of floor members. The short-span figures would be of utmost importance with respect to the determination of the proper formula, could we be certain that the results for varying span lengths are necessarily a consistent, continuous series. But this has not been established by test data, nor is it axiomatic, if impact is a composite of several actions.

In the observation of what the report calls "high-frequency vibrations" we have probably the most important new fact developed by this test series. The data are not wholly convincing as to the existence of such vibrations, yet it may prove that the phenomena is real and important. The bridge engineers of India, who are attacking the subject of impact with special vigor and to whom the revival of interest in the problem seems largely due, regard it as so essentially a matter of vibration that the recent report of C. W. Lloyd Jones on his study of impact practice in the United States is entitled "The Vibration of Railway Bridges."

Incidentally, the Lloyd Jones report suggests that it may be found most suitable to treat impact as an engine excess, since most of the impact arises from the engine and much smaller amounts are due to the wheels of the following trains, an observation well supported by H. S. Sales' report on the preliminary Indian impact measurements, which has just appeared. Major Mount's committee, on the other hand, recommends a formula of the Pencoyd type, but with higher values for very short spans and lower values for long spans than the formula current here. In view of these significant tendencies abroad it will be interesting to observe what contribution to the subject will be made by the American committee now considering bridge specifications.

Practical Hints on Operation and Maintenance

Central Mixing for Concrete Roads

By C. S. Hill
Associate Editor, *Engineering News-Record*

There are brought together in this article the conclusions of about two years' experience in concrete road construction by central mixing and wet-batch haulage. These conclusions are based on studies by the editors of many central mixing plant operations supplemented by opinions and data from highway engineers and contractors who have employed central mixing. The studies have been largely confined to the four states, Illinois, Wisconsin, Iowa and Minnesota, where the new practice is most common. They are of particular interest in view of the fact that outside of this group of states wet batch haulage has gained little favor and is forbidden by some highway departments.—Editor.

ILLINOIS in 1920-21 had a dozen central mixing plants employed in concrete road construction. In Wisconsin, Iowa and Minnesota the number of installations was smaller, but some of them were on unusually large operations. Except for occasional street-paving operations, the practice of central mixing in these states began in 1919. In that year a few plants were installed, almost experimentally by contractors, and approved by highway officials, with the mental reservation that the product should be rigidly scrutinized. Their operation disclosed no serious objections; in fact they made converts to central mixing of many contractors and highway officials. Two year's further experience has cooled the first enthusiasm and the engineer can now review the results in fair perspective.

General conclusions may be drawn as follows:

1. Where conditions favor their use, central mixing and wet-batch haulage are an economical method of concrete road construction.

2. The product has been accepted generally as meeting the requirements of prevailing specifications but it is considered necessary to keep careful watch of its quality.

3. The proportions and consistency of mixture which best endure transportation require investigation and a quantitative means of determining consistency is needed.

4. Mixing plant and hauling equipment practice has not been worked out and requires improvement in plan, co-ordination and details.

Of these conclusions the second and third are obviously the constants of the central mixing problem. Suitability of the method and, to a smaller extent, the plant equipment are determined by local conditions, but quality of product and means of ensuring this quality are invariable requirements. They determine the service value of the road while the other two factors only affect its construction costs. Discussion of product is, therefore, of most immediate importance and it separates into a consideration of (1) segregation, and (2) proportions and consistency.

Segregation

Segregation is a danger which obstructs all ways of transporting wet concrete. It is not peculiar to road construction. It calls for care in chuting the material a few scores of feet and it is a positive danger in carrying the material greater distances in trucks, cars and other containers. Therefore the road engineer has in segregation the common problem of all concrete construction but it is made more difficult by the greater distances which the material has to be transported. This thought is emphasized because there has been a disposition to magnify segregation into a danger peculiar to concrete road construction by central mixing.

When segregation occurs during transportation the only positive remedy is remixing. If, however, the separation of aggregates and liquid mortar is not excessive, methods of placing may remedy the condition sufficiently to overcome practical objections against the concrete being used. This is an important fact in concrete road construction. The placing of the concrete in a thin layer open to view permits minor conditions of segregation to be remedied in spreading and the use of the finishing machine, a practical necessity with concrete dry enough to be hauled a long distance, still further helps by its violent churning action to secure uniformity.

Concrete is hauled longer distances—one to three miles—in road construction than in other operations. It has been hauled five and six miles but there is reasonable doubt whether a longer haul than 2½ to 3 miles is economical if a considerable quantity has to be handled. Some engineers set the economic limit at a 40-min. haul. Because of the distance hauled, nearly always a jolting trip in trucks over rough roads, segregation is particularly likely. Its extent is determined by the following factors:

1. Time of haul and character of the road: the longer the batch is traveling and the more jolting it receives, the greater is the separation of the aggregates and the more firmly they are compacted in the bottom of the container.

2. Character of aggregate: a gravel mixture segregates more easily than does a broken stone mixture.

3. Consistency: segregation is least in dry mixtures.

4. Proportions: Proportions which give a well-graded and, therefore, a dense mixture, reduce segregation.

Consistency and Proportions

In actual road construction other factors than segregation control the character of the aggregate, the consistency of the mixture and its proportions. First, the aggregate which is economically available has to be used. Second, the proportions in most specifications are limited to 1:1½:3 and 1:2:4. More variation in consistency is practiced, but stiff mixtures are most common. Practically, the difficulty of placing and furnishing a dry mixture sets a constructional-economic limit to dryness for the mere purpose of decreasing segrega-

tion. With these general facts in mind, the results of experience with respect to consistency and proportions for wet-batch haulage can be stated as follows:

1. A dry mixture is best for wet-batch haulage. Dry concrete is a relative term but there is for concrete a certain consistency which endures transportation without serious segregation. A quantitative definition of this consistency has not been determined. A descriptive definition is about as follows: The concrete should not flatten out when dumped from the mixer into the truck but should stand slightly heaped, possibly 8 to 10 in., in the ordinary four-bag-batch container, and flatten out only after the truck has traveled several hundred feet. This consistency gives about a 1-in. slump, in the regulation test, for an ordinary gravel mixture. It makes about as stiff a concrete as is workable a concrete too stiff for hand finishing and requiring a finishing machine.

The standard slump test is not sufficient for determining the safe consistency of mixture for wet-batch haulage. It is indicative and should be retained but with skilled foremen and inspectors a closer check can be held on the mixture by its appearance as it is discharged from the mixer or from the truck at the end of the haul. The slump of a gravel concrete is different than that of a stone concrete. Also, the gradation of the mixture and the size of the aggregate effect the slump. Therefore, the slump of a concrete is not a close enough measure to detect the narrow zone of variation in wetness between a mixture which will segregate and one which will not. A few quarts of water will make a safe mixture unsafe in respect to segregation.

2. The proportions of the mixture are significant in west-batch haulage only as they affect gradation. Well-graded materials, that is, a dense mixture, decrease the tendency to segregate. The opinion sometime expressed by hauling crews that a 1:2:4, or some other, mixture cannot be hauled wet, is based on misapprehension. If a mixture is well graded it makes little difference in its tendency to segregate what its numerical proportions may be. In Iowa, where the use of pit-run gravel has been highly perfected, proportions as odd as 1:2½:1 have been hauled wet.

Construction Difficulties

Wet-batch haulage involves construction difficulties which do not exist when the mixing is done on the road. More weight has to be hauled and more work is required to place and finish the concrete.

With mixtures showing a 1 to 2-in. slump, trouble has been experienced generally in securing a dump body which will discharge all its contents. On short hauls and with ideal conditions the mixed concrete will dump without adhering, however, the major part of the time it is necessary to pick or dig a portion from the truck regardless of the type of body used. The packed material when loosened requires more work to secure uniformity in placing than where the concrete is distributed directly from the mixer onto the subgrade. The water in the mixed concrete of course, adds to the weight hauled compared with dry batch haulage.

A concrete dry enough to be hauled wet ordinarily cannot be finished economically by hand. With finishing machines little difficulty is experienced. During extremely hot weather it is necessary to wet the sand as well as the stone or gravel sometime in advance of the mixing. Enough water to saturate the sand is required. If it is not soaked the material will absorb water while the batch is being hauled and there will be trouble in dumping and finishing. Under normal conditions little difficulty is experienced in machine finishing concrete which has been hauled three or four miles, but in very hot weather the concrete is sometimes too stiff, after being hauled several miles, to be finished easily.

Roads built of concrete hauled from central mixing plants have not been long enough in service to indicate conclusively whether they are inferior or superior to roads built of concrete mixed on the grade.

Observation generally does not indicate that there is any difference in the strength of the concrete. This conclusion is supported by tests at three months of field specimens from a number of concrete road jobs in Iowa. On five jobs carried on in 1920 using 1:2:3½ sand- and gravel-concrete, the mixing was done on the road for three and at a central plant, with wet batch haulage, for two, and the results of crushing tests were as follows:

Average of 19 specimens, road mix	3,660 lb.
Average of 24 specimens, road mix	3,870 lb.
Average 30 specimens, road mix	3,990 lb.
Average of 21 specimens, central mix	3,600 lb.
Average of 26 specimens, central mix	3,460 lb.

There is radical difference of opinion respecting the uniformity of the concrete secured when central mixing and wet-batch haulage are employed. The extreme opinions may be summarized as follows:

1. In no case has it been possible to secure a uniform concrete when wet concrete was hauled. It is believed that unless the concrete is remixed after reaching the road a non-uniform pavement will result.

2. The concrete which is delivered by wet-batch haulage provides a satisfactory road.

Conclusion

In three of the four states whose experience has been reviewed central mixing with wet-batch haulage is considered a satisfactory construction method, when the work is carefully directed. In the fourth state inability to secure uniformity of product has raised the question whether the method should not be discontinued.

The complete success of wet-batch haulage required that some means of controlling segregation with more precision than is now practicable must be developed.

Power Gas from Birmingham Sewage Sludge

Promising results from the utilization of gas derived from sewage sludge are indicated by experiments conducted under the direction of John D. Watson, engineer of the Birmingham sewage-works, England, according to a paper presented by him to the Engineering Section of the British Association for the advancement of science, about the middle of September. Notwithstanding various drawbacks, including the lack of a gasholder, gas was produced at low cost, says the London *Surveyor* of Sept. 23. The engine used is described as "a standard town gas engine, capable of giving 34 brake horsepower maximum with town gas having a calorific value of 500 to 550 B.t.u." The tests indicated that sewage sludge would yield a gas of 650 to 700 B.t.u. Mr. Watson estimated that the 9,000 (long) tons of dry solids in the sewage sludge produced yearly at the Birmingham sewage-works could be made to yield 320,000,000 cu.ft. of gas, equal to 16,000,000 hp.-hr., taking 20 cu.ft. per brake horsepower. This would give 4,400 hp. per day of 10 hours.

Concrete Girders Jacked Up To Replace Settled Bridge Pier

By William J. Titus

Bridge Engineer, Indiana State Highway Commission, Indianapolis, Ind.

By supporting two concrete girder spans on jacks while a settled pier was removed and replaced, the Indiana State Highway Commission was able recently to repair a damaged bridge at a cost of about $1,800 when a new one would have cost $15,000.

The bridge, on Road 33, about 2½ miles west to Waynetown, Fountain Co., consists of a four-span reinforced-concrete deck girder bridge with a 17-ft. roadway and total length of 100 ft. face to face of abutments. It was built less than 10 years ago, but the west pier had never been founded upon the solid limestone which existed only a few feet below the bottom of the old

TWO SPANS AT LEFT WERE JACKED UP AND THE PIER CARRYING THEM REPLACED

foundation. This pier had settled about 6 in. on one end and 8 in. on the other, seriously cracking the pier and so cracking the adjacent girder spans that it was feared that it would be impossible to raise the spans without destroying them.

The program, therefore, was to raise these spans to their original position, blast out the old pier, excavate the foundation to the bedrock and replace the pier with a new one of concrete. The adjacent spans consist of five reinforced concrete T-beams 12 in. wide and 2 ft. 4 in. deep on the underside of the 6-in. roadway slab. A 10-in. handrailing 3 ft. 7 in. high existed on each side of the old bridge. The contractor first excavated at each end of the old pier and built timber grillages about 10 ft. square. On top of these grillages he placed some heavy timbers to distribute the load and then placed two 10-in. 25-lb. I-beams on each side of the pier. At each end of each pair of these I-beams were placed four screw-jacks and a man was placed to operate each jack continuously until the spans were raised to their proper position.

CRACK IN PIER DUE TO SETTLEMENT

The total load to be supported was approximately 132,000 lb. so that each jack had to carry approximately four tons. A little computation makes it evident that the I-beams were very seriously overstressed, to almost 45,000 lb. per square inch. In fact a measured deflection in these I-beams of 2½ in. very quickly developed. Contrary to our fears the stress in the I-beams was not beyond the yield point and no additional deflection developed. It had been suggested to the contractor that larger beams would be necessary but he was sure that "four 10-in. beams would hold up almost anything."

The blasting out of the old pier, the excavation to bedrock about 8 ft. below low water level, and the placing of the new pier proceeded without any unusual incidents. The weight of the spans was lowered on to the new concrete, the centering removed and the bridge opened Aug. 28, about sixty days after work started.

Sewer Grades and Sewage Disposal

A British View on Dilution Standards, Activation by Spiral Movement, Low Sewer Velocities and Sewage Utilization

Activated sludge as a means of sewage treatment, sewage disposal by dilution with special reference to dilution standards and to experience with the Chicago Drainage Canal, some of the high points in a report on sewerage and sewage disposal for a South American city, with special reference to the permissibility of low sewer grades and to sewage disposal by dilution or possible use of the sewage for irrigation in the future, were features in the second annual presidential address of Arthur J. Martin, consulting engineer, London, England, before the Association of Managers of Sewage Disposal Works some months ago.

In reviewing briefly the activated-sludge process in England and the United States, Mr. Martin referred to the adoption of a process for the treatment of the sewage of Worcester and Reading in England and of Milwaukee and a part of the Sanitary District of Chicago in the United States. Mention of Chicago naturally led up to the Chicago Drainage Canal and to the remark that "no greater or more daring experiment in the disposal of sewage by dilution has ever been made." Mr. Martin then characterized the results as "far from satisfactory" and gave the following comparisons of standards of dilution in terms of the amount of clean water in cubic feet per minute required to dilute the sewage of 1,000 people, as follows:

Chicago, as originally considered necessary	200
Chicago, allowed by Secretary of War	100
Chicago, actually used	168 to 216
Proposed by Committee of American Public Health Association	240 to 360
Proposed by English Royal Commission	1,667

After noting that the dilution proposed by the Royal Commission is 4½ to 7 times that proposed by the American Public Health Association and 8 to 10 times that actually used in Chicago, Mr. Martin says that obviously the commissioners did not intend their recommendations to be applied too literally, since nothing is said about the strength of the sewage. Account also must be taken of the conditions governing the admixture of the sewage in the water. Mr. Martin added: "I have seen the sewage from a tank floating in an unmistakable layer on the surface of the sea, although the volume of the latter must have been many million times" that of the sewage. "For these and other reasons," Mr. Martin stated, "a very liberal margin of safety must be allowed" in all proposals for sewage disposal by dilution.

Mr. Martin's outline of a sewage disposal problem in South America with which he had to deal (apparently in 1920), in the course of which he made some interesting remarks on sewer grades and on final disposal of sewage, were in part as follows:

A population of 100,000, rising to a quarter of a million; a city occupying some 1,700 acres of land; bounded on the north by a range of hills, on the east by a large tidal river, on the west by a long tortuous arm of the sea, on the south by a low level plain stretching far down the river. The natural level of the ground in the city below high-water mark of the highest tides; the improved portions 3 or 4 ft. higher. A water supply of 8.8 Imp. gal. per head per day, to be increased shortly to 44 Imp. gal. No manufactures likely to affect the composition of the sewage. A rainfall confined to the period from December to June, with frequent falls at the rate of 1 in. per hour or over and a recorded fall of 6 in. in 1 hr. and 50 min. No existing sewers other than a few surface water drains, receiving also some sewage.

The combined system was out of the question, for to carry the largest recorded rainfall with a velocity of 3 ft. per second a tunnel 47 ft. in diameter would have been required. It was impracticable even to provide sewers to carry the rain water from the back slopes of the roofs and the inner courts of the houses.

Recourse to pumping seemed to be inevitable, for the sewage must be carried clear of the furthest limits of the future city. The heads of some of the sewers will be more than six miles from the outfall; and fall is woefully scanty. The only hope of avoiding pumping lay in the rise and fall of the tides, which range from 6½ to 12½ ft. Self-cleansing velocities were of course a *sine qua non*.

A Heretic on Sewer Gradients

I am, as some of you may be aware, a bit of a heretic in the matter of sewer gradients. We are told in the textbooks that a sewer cannot be relied on to keep itself clear if the velocity of the sewage is less than 2, 2½ or even 3 ft. a second. As a matter of fact I doubt whether there is a town in England without many sewers in which the lowest of these velocities is seldom, if ever, attained. True, the sewers are laid at gradients which give the desired velocity —on paper; but the flow in them is ordinarily so small in relation to their capacity that the velocity is nowhere near that which the gradient is tabled to give. And yet, in defiance of the prophets, these sewers persist in keeping themselves clear. I know one such sewer in which, through the scantiness of the present water supply, the ordinary velocity is about 1 ft. per second, but from which no trouble has ever been experienced.

Undoubtedly many flat sewers do silt up, or even choke, and for this the gradient has generally to bear the blame. Many an innocent man has been hanged on this kind of evidence. I have not the slightest doubt that, if every case of chokage could be investigated, the trouble in 19 cases out of 20 would be found to be due, not to the flatness of the gradient, but to faulty laying, and in particular to the infusion of jointing material into the pipe. I therefore attach far more importance to workmanship than I do to gradient.

At the same time, when one goes to a foreign country, one has to forget a great deal that one has learnt at home, in order that he may approach the new conditions with which he is confronted with an even and unbiased mind. I was prepared to find that with the higher ground temperatures which prevail in the tropics it might be advisable to use velocities somewhat greater than had proved sufficient in one's home experience. Accordingly, I took the opportunity afforded by a stay of a few days at Cristobal (at the northern entrance to the Panama Canal) to obtain some information concerning the sewerage of that city. I found that the gradients of the sewers were uniformly flat—much flatter in fact than are used in the majority of English towns. Several 6-in. sewers, for instance, are laid with falls of 1 in 330. They receive no special treatment in the matter of flushing; and they give no trouble. To be strictly accurate, one of these flat 6-in. sewers did choke; and it had to be relieved of a couple of overalls and a shirt. But you could hardly blame the gradient for that.

The standard which I set before myself was a maximum velocity of 2 ft. per second at the hours of greatest flow, and more where practicable; and I resolved if possible to secure such velocities by gravitation. The outlook was not encouraging, but by collecting the sewage as quickly as possible into large trunk sewers which could be laid at very flat gradients, so as to economize fall for use in the branches, I was able to give every sewer a self-cleansing gradient without recourse to pumping. As an additional safeguard, means will be provided for flushing most of the sewers at high tide from the river or from the tidal creek to the west of the city.

An oval cross-section is frequently used for the purpose of getting a better velocity with small flows than can be obtained in a cricular sewer; and it occurred to me that this might be done with advantage in the case of my outfall sewer. But on going into the matter I found that, so far from the velocities being better with an oval sewer, they were worse with all depths of flow. This unexpected result was due to the flattening of the gradient through the fall absorbed by the greater height of the cross-section.

The question of disposal presented but little difficulty. The river which flows past the city drains an extensive watershed, large tracts of which are covered with perpetual snow; and the dry-weather flow in one of its tributaries which has been gaged would more than satisfy the requirements of the committee of the American Public Health Association in connection with the discharge of crude sewage. And over and above this there is the mighty volume of salt water which sweeps up the river at every tide. The current is very swift; and there are no towns, and but few houses, on the banks of the river below the city. It was clearly a case for disposal by dilution. The outfall will be three miles below the present boundary of the city, and the sewage will be stored while the tide is rising, and during the period of high water, and discharged on the falling tide.

Regarded merely from the point of view of disposal, discharge into the river is undoubtedly the best method which can be adopted; but there is another consideration which should not be lost sight of. The country lives by its agriculture. Year by year it makes a heavy draft on the fertility of the soil. The reserves of productiveness are doubtless immense. But should we be justified in squandering the enormous amount of plant food which the sewage of a quarter of a million people contains? And apart from its manurial value, 50,000 cu.m. of water per day, in a country where no rain falls for six months at a time, is an asset not to be despised. The Incas who ruled the country before its conquest by the Spaniards carried out some admirable irrigation works, most of which have long since fallen into decay.

It would be a simple and inexpensive matter to pump the sewage from the outfall sewer on to the land along its course. During the rainy season, when the soil receives from the clouds all the moisture which it can profitably utilize, the sewage would pursue its course to the river.

Crops for Tropical Sewage Farm

You may be interested to know the kind of crops which a high authority on tropical agriculture recommends for a tropical sewage farm. I quote from his letter:

"I should say that the greatest benefit from the sewage would come from its water content rather than from its fertilizer content. . . . The land would become very much more valuable than it is at present, as paying crops could be planted. Chief among these I would place the cocoanut palm, which would yield exceedingly well if they could be kept irrigated during the dry season. Some fruits such as mangos and avocados, and several annuals such as maize and beans, and also cotton, which is grown in these climates as a perennial. All of these could be used as catchcrops between the cocoanuts until they came into bearing."

I may add that the soil is a stiff clay. It contracts and cracks when dry, and it will not readily absorb water. My

correspondent is of opinion that it will take sewage during the dry season at the rate of 3,000 gal. per acre per day. Should a sewage farm be established, skilled management would of course be essential.

Mr. Martin did not even consider it necessary to screen the sewage, at least for years to come. If, later on, some treatment of the liquid portion of the sewage of the city in question became desirable, "the activated-sludge process would have strong claims to consideration, possessing as it does the great practical advantage that the treatment may be varied in amount, or even suspended altogether, according to the needs of the moment."

Activation by Spiral Flow in Outfall

Should the activated-sludge process be ultimately adopted in this South American city, Mr. Martin said that it might be possible to utilize the long outfall sewer, 5 ft. in diameter and three miles in length, in place of the usual activated-sludge tank by putting into effect a principle that he had suggested in his address a year earlier. This was to cause "sewage to travel in a spiral direction in a long tubular chamber at a velocity sufficient to keep the sewage, the air and the sludge intimately intermixed." In the case of the outfall sewer just mentioned, "the rotation of the sewage would be affected" by centrifugal pumps, "a due proportion of air being drawn into the suction pipes and thoroughly churned up with the sewage in the pumps." Reinforcement of the spiral motion would probably be necessary at intervals along the outfall and "the requisite amount of sludge would have to be pumped back" from the lower end to the head of the outfall. While "it may be that the purification effected in this way will be less complete than that obtained by means of diffusers, the circumstances are not such as to call for a high degree of purification."

On the future of sewage disposal, Mr. Martin said, at the conclusion of his address:

> The whole history of sewage disposal forbids us to believe that finality has yet been reached. There was some excuse for thinking so ten years ago, for the bacterial purification of sewage followed nature so closely—her share in the work was so large, and man's so small—that it did seem as if we were at last on the right lines. And now forced aeration has taken the foremost place, and finality seems as far off as ever.
>
> There are two processes of sewage treatment, and only two so far as I am aware, of which it is safe to say that they will never be superseded, purification by dilution, and purification by means of land.
>
> It is proverbially dangerous to prophesy; but I venture to predict that among the developments of the near future will be a fuller utilization of the manurial constituents of sewage, and a more general recovery of grease. We were all spendthrifts before the war. But now the need for economy is urgent; and the sewage-works manager must do his part.

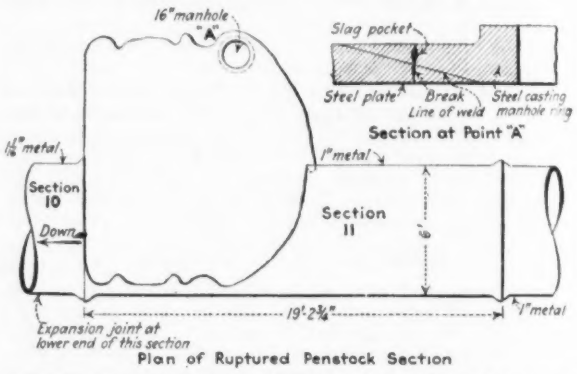
Jackson Lake Reservoir Full for First Time

For the first time since 1916 when it was raised to its present elevation the Jackson Lake reservoir in Wyoming was filled in June to its designed capacity of 847,000 acre-ft. Water from the run-off of the 820 sq. miles of area tributary was available in 1917 and 1918 but leakage in the 4,500-ft. earth dike made it inadvisable to fill the reservoir to its full height, according to the *Reclamation Record* for September. This reservoir supplies water to 750,000 acres of land in the Snake River Valley in Idaho, one of the largest areas in the world irrigated from a single reservoir.

Penstock Bursts During Tryout of High-Head Turbine Plant

Six-Foot Pipe Under 560 Feet Head Ruptures After Heavy Short-Circuit—Structural and Operating Conditions

THE hydrolectric plant known as Big Creek No. 8, which was recently completed in California by the Southern California Edison Co., was put out of commission on Aug. 20 for twenty-three days by the bursting of the penstock at a point about 200 ft. from the power house. The break occurred immediately after a short circuit on the transmission line that caused a surge in the penstock, and the fracture occurred in a steel manhole casting which proved, on later examination, to have a defect in the form of a slag pocket. Because of the solid rock and well-founded concrete saddles supporting the pipe where the break occurred,



RUPTURED PENSTOCK SECTION AND SLAG POCKET IN MANHOLE RING CASTING

(In "Section at Point A" the line of the weld is shown closer to the manhole than it is in the actual pipe.)

neither the shape nor the alignment of the penstock was disturbed on either side of the section that burst, though the upper part collapsed under external pressure as the water rushed out. The break was repaired by cutting out the damaged portion with a torch and fitting into place a sleeve which was then riveted to the two open ends after the necessary rivet holes had been drilled. The section removed was about 19 ft. long.

The Big Creek No. 8 plant operates under a head of 680 ft. and has a penstock 2,800 ft. long varying in inside diameter from 8 ft. at the top to 6 ft. at the power house, and in thickness from ⅜ in. to 1⅛ in. The upper part is riveted pipe, the lower part hammer-welded, with riveted joints between sections. The rupture occurred one length above an expansion joint in the welded pipe, and passed close to a manhole on the upper side of the pipe. Th static head at this point is about 560 ft.

Conditions at Time of Accident.—The single unit installed at this plant has a capacity of 22,500 kw., but up to the time of the accident it had not been carrying a load in excess of 15,000 kw. The plant had been under test for four days and on the night previous to the break was put on governor control for the first time. The unit was then developing approximately 10,000 kw. and was operating at about ⅓ gate opening.

As nearly as the facts can be established from available data, at the time the short circuit occurred, shortly before 6 a.m., the gates opened and the unit took on an

additional load; some accounts estimate this additional load as high as 10,000 kw. Immediately thereafter, it is stated, the short cleared and the turbine gates closed.

Attendants at the plant describe the rupture of the pipe as a progressive occurrence. With the first report, presumably marking the first escape of water through the weak spot of the manhole-ring casting where the slag pocket was later found, a small stream of water, apparently from the top of the pipe and under extremely high pressure, shot high in the air and passed entirely over the power house. This was followed by a rapidly broadening stream of larger volume that struck the temporary end wall of the power house squarely and swept into the structure. The broader stream is believed to have marked the longitudinal ripping of the pipe, which occurred for a length of 8 to 10 ft. Later still a circumferential tear laid the ruptured section wide open. In its final position this portion of the side wall of the pipe was almost flattened down on the ground. The circumferential tear and the large opening it caused were on the side away from the power house, and the larger volume of water was diverted away from the structure during the remainder of the flow.

Gages and other instruments in the plant were damaged by the stream of water entering the plant, so that complete operating data are not available. It is stated, however, that the short circuit caused a sudden draft of water resulting in a drop in pressure in the penstock of about 30 lb. per sq.in., which may have caused a break in the water column. On this analysis the closing of the turbine gates, upon clearing of the short circuit, retarded the lower water column to such an extent that it was rammed by the upper water column, thus producing a destructive pressure rise.

Construction Incomplete.—When the break occurred the plant was operating without forebay or surge chamber. Construction on that feature of the development had not been completed, and a by-pass or temporary direct connection between tunnel and penstock was being used. This connection consisted of a 6-ft. pipe and was about 150 ft. long. The air-vent at the upper end of the penstock consisted of a 6-in. pipe.

At the time of the break the sudden release of water under spouting velocity emptied the pipe quickly, collapsing the riveted pipe at the upper end of the penstock for a distance of approximately 450 ft. The collapsed section of the pipe has since been restored to approximately the original shape by filling the pipe and subjecting it to a slight additional pressure, a temporary bulkhead in the lower end of the collapsed section being used meantime to hold the water. This collapsed section extended down to an expansion joint in the first length of welded pipe. The expansion joint was pulled open by the collapse of the pipe above.

Break Not at Welds.—The line of break of the ruptured section of pipe passed along the manhole-ring casting but did not cut across the ring, as may be seen in the plan sketch herewith. Except at this manhole, the break did not follow welded joints but went through the metal. The longitudinal tear crossed a circumferential weld, and the circumferential part of the break occurred about a foot beyond that weld. There was some 5,000 lin.ft. of welded joint in the penstock, none of which gave any evidence of weakness in the stress of the accident.

Slag Pocket in Manhole Casting.—Early reports stated that near point *A* (see sketch) of the pipe a discoloration about $\frac{1}{2}$ x $2\frac{1}{2}$ in. on the fracture face indicated a defect in the welded joint between plate and manhole casting. Closer examination showed this spot to be outside the weld, wholly in the casting, and to represent a slag pocket in the casting. The break, in fact, passed across the weld face. A sketch of the conditions, furnished by the M. W. Kellogg Co., makers of the welded pipe, is given in the drawing herewith.

Samples taken from this point as also from other parts of the fracture were examined by the New York Testing Laboratories. Their report on microscopic study of the samples states that both plate and casting are of excellent character, but that just at the slag pocket the casting has a large-mesh structure of decidedly weak type, and many slag inclusions.

The pipe had passed both shop and field pressure tests before the plant was put in operation. In the shop tests, each length was subjected to 50 per cent excess of pressure over the final static head. In the field, the penstock as a whole after completion was tested under full static head. No difficulties or weaknesses developed in these tests.

Effect of Drought on British Roads

(London Correspondence)

British road engineers are complaining of the effect of the prolonged drought on road surfaces. This has not been so apparent in the cities, where the surfaces are asphalt or wood block, nor on the country highways surfaced with tarmac. On all roads, however, which have been surfaced with macadam or gravel, the effect of the prolonged absence of rain has been very marked. In the majority of such cases, especially where the top covering has been comparatively thin, this covering has been broken up and ground to powder by heavy vehicles, especially by motor coaches, the effect of the absence of moisture being to present a brittle shell to heavy traffic. The wind has carried away this powder leaving exposed jagged flints and stones.

In some cases cracks have ensued, so that the entire bed has thoroughly disintegrated. In fact, in traversing some of these roads in an automobile, one has the impression of utilizing a country track which has never yet had the attention of a road engineer. Much repair work on these and other roads must be done in the short space of time between the arrival of necessary rain supplies and the heavy and continuous winter falls when such work is impossible. In the majority of rural districts where local authorities are dependent on wells for water, none has been available for steam roller use so that urgent repairs are necessarily delayed.

Foreign Commerce for August

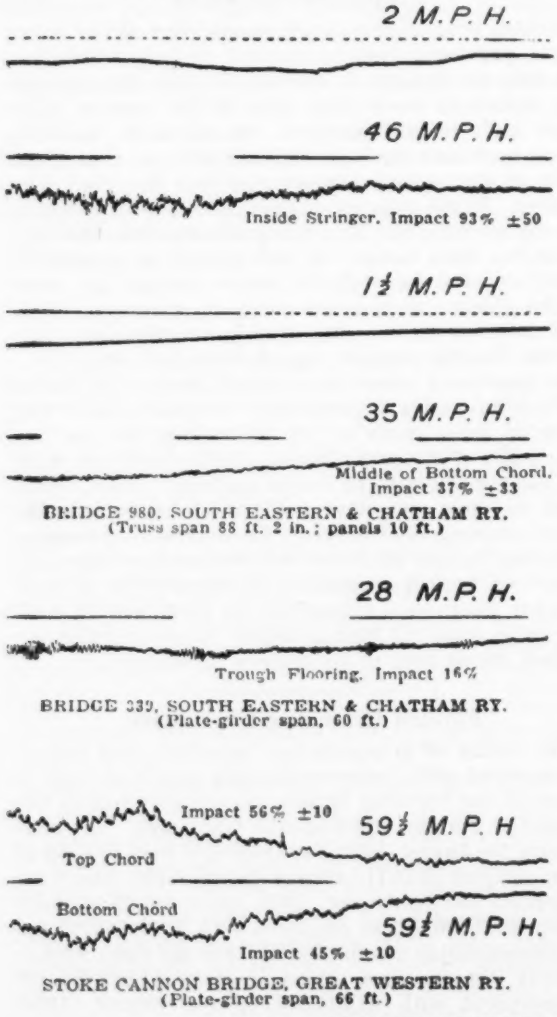
The falling off in exports and imports during August as compared with the corresponding month of 1920 is shown in the following figures recently compiled by the Bureau of Foreign and Domestic Commerce. The total imports for August, 1921, were valued at $194,767,564 as compared with $513,111,488 for August, 1920. The value of exports during August, 1920, amounted to approximately $372,000,000 as compared with $578,000,000 for the corresponding month of 1920. For the eight months of 1921 imports were valued at about $1,693,000,000 as compared with $3,994,000,000 for August, 1920, and exports at about $3,227,000,000 as compared with $5,475,000,000 for August, 1920.

Results of Impact Tests on Bridges in England

Photo-Recording Strain Gage Applied to 20 Bridges Yields 362 Records — High-Frequency Vibrations Found Especially in Floor Systems—General Agreement With Prior Tests—A New Formula Proposed

AN ELABORATE set of experiments to measure impact effects in railway bridges was carried out during the past year in England by a subcommittee on bridge specifications, acting for an advisory committee for the revision of the Board of Trade requirements in regard to the opening of railways. A report on these tests has just been issued by the Ministry of Transport, the report being prepared by Major A. Mount, Inspecting Officer of Railways in that department. The work done is notable because of the number of measurements made, the use of a photo-recording strain gage of high sensitiveness and low inertia, the presence of high-frequency vibrations in the record curves, and the conclusion of the subcommittee that a new impact formula is desirable, of the same form as the Pencoyd but with different constants. The main features of the report are summarized in the following paragraph.

When discussing permissible working stresses for railway bridges, in May 1920, the subcommittee recognized "that there was divergence of practice among railway companies in dealing with impact effect. Some vary the permissible working stress of 6½ tons per square in. in accordance with the span, or with a range-of-stress formula, while a minority make no allowance." Because of these facts and the active interest in the subject already manifested by railway bridge engineers in India, the adoption of a uniform specification was considered desirable. "The adoption of the Pencoyd formula was contemplated, but it was recognized that the view was held by engineers that this formula



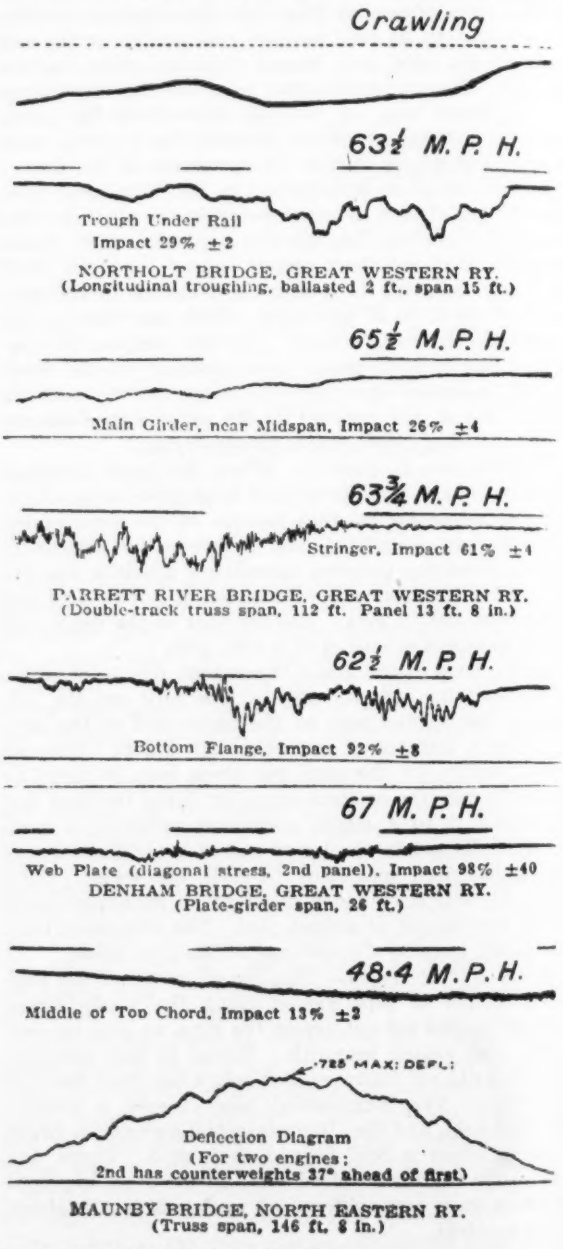

Crawling
63½ M.P.H.
Trough Under Rail
Impact 29% ±2
NORTHOLT BRIDGE, GREAT WESTERN RY.
(Longitudinal troughing, ballasted 2 ft., span 15 ft.)
65½ M.P.H.
Main Girder, near Midspan. Impact 26% ±4
63¾ M.P.H.
Stringer. Impact 61% ±4
PARRETT RIVER BRIDGE, GREAT WESTERN RY.
(Double-track truss span, 112 ft. Panel 13 ft. 8 in.)
62½ M.P.H.
Bottom Flange. Impact 92% ±8
67 M.P.H.
Web Plate (diagonal stress, 2nd panel). Impact 98% ±40
DENHAM BRIDGE, GREAT WESTERN RY.
(Plate-girder span, 26 ft.)
48·4 M.P.H.
Middle of Top Chord. Impact 13% ±2
·725" MAX: DEFL:
Deflection Diagram
(For two engines;
2nd has counterweights 37° ahead of first)
MAUNBY BRIDGE, NORTH EASTERN RY.
(Truss span, 146 ft. 8 in.)

FIG. 1. SPECIMEN RECORDS OF ENGLISH TESTS OF BRIDGE IMPACT
(The curves are reproduced full original size, but show only short sections of the records)

TABULATED RESULTS OF IMPACT TESTS ON ENGLISH BRIDGES FOR COMMITTEE OF MINISTRY OF TRANSPORT

Railway.	Bridge.	Calculated Ratio $\frac{D}{L}$ Main Girder.	Type of Floor.	Engines. Two Cylinder.	Member.	Effective Span or Loaded Length.	Instrument No. and Test Series.	Maximum Speed m.p.h Test Series.	Speed at Maximum Recorded Impact.	Cal. dead load stress in member Tons per sq. in.	Calculated stress due to live load (static). Tons per sq. in.	Recordeal stress due to live load (static). Tons per sq. in.	Maximum recorded live load stress. Tons per sq. in.	Maximum recorded increment per cent., col. 14 compared with col. 13.	Maximum recorded increment per cent.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	17.
S.E. & C.R.	1577	·48	B.	one	C.T.	10′ 4″=4′	V. 1–7	58	58	0·834	2·98	1·18	1·90±5	61±4	—
S.E. & C.R.	473	·52	B.	„	C.T.	12′ 9″=5′	V. 58–62	42	28	0·17	1·28	0·93	1·08	16	—
G.W.R.	Denham	·46	B.	two	C.T.	11′ 6″=6′	VI. 116–120	62·5	51·5	0·69	3·91	2·20	2·60	18	—
G.W.R.	124/21	·28	B.	„	C.T.	11′ 8″=6′	V. 83–87	67·5	67·5	0·575	3·73	1·71	2·40±9	40±5	—
S.E. & C.R.	134	·56	O.	one	R.B.	7′ 6″	VI. 42–47	58	58	0·129	1·65	1·67	3·18	90	—
S.E. & C.R.	134	·56	O.	„	R.B.	7′ 6′	V. 42–47	58	58	0·134	1·65	0·87	2·25±11	159±13	—
G.W.R.	Staffords	·35	O.	two	R.B.	8′ 0″	VI. 63–67	56	55	0·59	3·07	1·12	1·90±14	70±12	—
G.W.R.	Parrett	·35	B.	„	R.B.	8′ 0″	V. 98–101	63	63	0·396	3·78	0·90	1·50	67	—
S.E. & C.R.	980	·94	O.	„	R.B.	9′ 8″	V. 19–25	54	46	0·277	2·57	0·89±11	1·57	79±22	—
S.E. & C.R.	980	·94	O.	„	R.B.	9′ 8′	VI. 19–25	54	46	0·277	2·57	0·78±17	1·42±6	93±50	—
L. & N.W.R.	45	·65	O.	„	C.G.	10′ 0″	VI. 178–181	65·5	65·5	0·44	1·49	1·22	1·95	60	43
G.W.R.	Blackthorn	·94	B.	„	R.B.	10′ 8″	V. 106–110	64·5	64·5	0·43	3·09	1·65	2·55±14	54·5±9	—
L. & N.W.R.	27	1·98	J.A.C.	„	C.G.	12′ 0″	VI. 170–172	65·5	65·5	0·96	1·33	0·5	0·81	62	—
G.W.R.	Parrett	·62	O.	„	R.B.	13′ 8″	VI. 88–92	64·75	63·75	0·23	4·00	1·85	2·98±6	61±4	—
G.W.R.	Stoke Cannon	·81	O.	„	R.B.	14′ 8″	VI. 71–75	63·5	54	0·24	3·66	2·12	2·65	25	—
G.W.R.	Northolt	·5	B.	„	L.T.	15′ 0″	V. 126–130	63·5	63·5	2·77	5·56	2·50	3·22	29	—
S.E. & C.R.	134	·56	O.	one	C.G.	15′ 1″	VI. 48–51	63	63	0·437	2·39	1·85	3·54±23	91±12	—
G.W.R.	Parrett	·35	B.	two	C.G.	16′ 0″	VI. 98–101	63	63	0·66	3·30	2·12	3·09	46	—
G.W.R.	Staffords	·35	O.	„	C.G.	16′ 0″	V. 63–67	56	56	0·22	2·93	2·28	3·15	38	—
S.E. & C.R.	980	·94	O.	„	C.G.	20′ 0″	V. 26–29	57·5	57·5	0·662	1·84	1·20	1·93±8	61±7	—
S.E. & C.R.	339	·185	O.	one	P.F.	21′ 4″	V. 35–40	57·5	47	0·33	1·78	1·42	2·1±7	48±5	—
G.W.R.	Blackthorn	·94	B.	two	C.G.	22′ 0″	VI 106–110	64·5	64·5	0·88	2·27	1·25±5	1·70±10	36±13	—
S.E. & C.R.	1597	·54	B.	one	P.F.	23′ 4″	VI. 8–18	55	55	0·633	1·17	1·08	1·31	26	14
G.W.R.	124/21	·28	B.	two	P.F.	25′ 0″	VI. 83–87	67·5	38	0·716	2·60	1·53	2·07	35	—
G.W.R.	Denham	·46	B.	„	P.F.	26′ 0″	V. 116–120	62·5	62·5	1·66	3·60	1·55	2·98±13	92±8	20
G.W.R.	Denham	·46	B.	„	P.W.	26′ 0″	VI. 121–125	67	67	0·27	0·89	0·43±5	0·85±7	98±40	—
G.W.R.	Denham	·46	B.	„	P.F.	26′ 0′	V. 121–125	67	67	1·03	2·20	1·25	1·95	56	20
G.W.R.	Parrett	·62	O.	„	C.G.	28′ 0″	V. 88–92	64·75	64·75	0·39	2·08	1·20	1·73	44	21
G.W.R.	Stoke Cannon	·81	O.	„	C.G.	29′ 0″	V. 71–75	63·5	63·5	0·45	2·08	1·35	2·00	48	—
S.E. & C.R.	1577	·48	B.	one	P.F.	30′ 0″	VI. 1–7	58	45	0·652	1·38	1·05	1·44	37	22
G.W.R.	Parrett	·35	B.	two	P.F.	42′ 0″	V. 102–105	59	59	1·18	3·34	1·60	2·21	38	—
G.W.R.	Parrett	·35	B.	„	P.F.	42′ 0″	VI. 102–105	59	59	1·18	3·34	0·80	1·00	25	—
L. & N.W.R.	31	1·00	J.A.L.	„	R.B.	44′ 7″	V. 161–163	64·5	64·5	1·82	1·70	0·17	0·30	76	—
L. & N.W.R.	31	1·00	J.A.L.	„	R.B.	44′ 7″	VI. 155–160	84	84	2·23	2·20	0·52	0·75	44	—
S.E. & C.R.	825a	·65	B.	one	P.F.	48′ 0″	V. 52–55	60	45	1·031	1·59	0·80	1·42	77·5	40
S.E. & C.R.	825a	·65	B.	„	P.W.	48′ 0″	V. 56–57	52	52	0·259	0·46	1·17	1·55	32·5	—
S.E. & C.R.	134	·56	O.	„	P.F.	56′ 8″	V. 48–51	63	43	0·863	1·53	1·07	1·50	40	16
S.E. & C.R.	473	·52	B.	„	P.F.	60′ 0″	VI. 58–62	42	42	1·71	3·27	2·05	2·23	9	—
G.W.R.	Staffords	·35	O.	two	P.F.	64′ 0″	V. 68–70	59·5	59·5	1·17	3·3	2·20±13	3·43	56±10	40±8
G.W.R.	Staffords	·35	O.	„	P.F.	64′ 0″	VI. 68–70	59·5	59·5	1·38	3·9	2·12±15	3·05	45±10	26±9
L. & N.W.R.	27	1·98	J.A.C.	„	P.F.	66′ 4″	VI. 164–169	67	67	3·18	1·60	0·65	0·94	45	—
L. & N.W.R.	27	1·98	J.A.C.	„	P.F.	66′ 4″	V. 164–169	67	67	2·57	1·31	0·95	1·34	41	—
L. & N.W.R.	45	·65	O.	„	P.F.	75′ 6″	V. 173–177	67	67	1·51	2·31	1·09	1·45	33	—
L. & N.W.R.	45	·65	O.	„	P.F.	75′ 6″	V. 178–181	65·5	65·5	0·95	1·51	0·41	0·73	80	17
S.E. & C.R.	980	·94	O.	„	L.C.	88′ 2″	VI. 30–32	57	35	1·147	1·44	1·10±5	1·51±31	37±33	—
S.E. & C.R.	980	·94	O.	„	L.C.	88′ 2″	V. 33–34	58	58	0·616	0·77	0·37	0·58±15	57±40	—
S.E. & C.R.	980	·94	O.	„	L.D.B.	88′ 2″	VI. 33–34	58	58	1.138	1·34	1·30	2·02±50	55±40	—
G.W.R.	Blackthorn	·94	B.	„	P.F.	94′ 0″	VI. 111–115	65·5	65·5	2·43	2·59	1·40	1·90	36	20
G.W.R.	Blackthorn	·94	B.	„	P.F.	94′ 0″	V. 111–115	65·5	65·5	1·94	2·07	1·92	2·45	30	23
N.E.R.	Tees Viad.	·48	O.	„	L.D.B.	100′ 0″	V. 149–152	60	60	1·865	3·38	3·15	3·78	20	10
N.E.R.	Tees Viad.	·48	O.	„	L.V.B.	100′ 0″	VI. 149–152	60	60	1·236	2·57	1·40	1·70	21	—
G.W.R.	Parrett	·62	O.	„	L.C.	112′ 0″	VI. 93–97	65·5	65·5	1·33	2·14	1·41	1·77±5	26±4	—
G.W.R.	Parrett	·62	O.	„	L.C.	112′ 0″	V. 93–97	65·5	63	1·33	2·14	0·75	1·07	43	—
N.E.R.	Tees Viad.	·48	O.	„	L.C.	116′ 3″	V. 143–148	58	44·8	1·83	3·81	1·30	1·90±19	46±15	21±14
N.E.R.	Tees Viad.	·48	O.	„	L.C.	116′ 3″	VI. 143–148	58	58	1·593	3·32	1·14	1·32	16	—
G.W.R.	Stoke Cannon	·81	O.	„	L.C.	132′ 0″	VI. 76–78	64·5	64·5	1·69	2·126	1·3	1·6	23	13
N.E.R.	Maunby	·634	O.	„	L.C.	146′ 8″	V. 133–142	56·8	52·4	1·82	2·76	0·97	1·57±7	62±7	26±7
N.E.R.	Maunby	·634	O.	„	L.C.	146′ 8′	VI. 133–138	56·8	48·4	1·44	2·18	1·85±5	2·10	13	5
N.E.R.	Maunby	·634	O.	„	L.C.	146′ 8′	VI. 139–142	56·8	44·4	1·78	2·70	0·87±10	1·31±10	51±30	18±40

Types of floor:— O. Open (unballasted) B. Ballasted. J.A.C. Cross Jack Arches J.A.L. Longitudinal Jack Arches

Members:—

C.T. Cross Trough. R.B. Rail Bearer. P.F. Plate Girder Flange. P.W. Plate Girder Web. L.V.B. Lattice Girder Web, Vertical

L.T. Longitudinal Trough. C.G. Cross Girder. L.C. Lattice Girder Chord. L.D.B. Lattice Girder Web, Diagonal. H.F.V. High Frequency Vibrations.

Notes.—In the case of cross troughing the loaded length has been taken as the assumed width over which distribution takes place.

$\frac{D}{L}$ is the ratio of the calculated dead load to the calculated effect of the test live load on the main girder tested.

The live load stress shown in Columns 12, 13, 14, refers to the test load.

provides inadequately for small and excessively for large spans." It was thereupon decided to make measurements of impact in a number of bridges. The instructions governing these measurements were: "To determine, as a provisional measure, pending further more extended experiments which, it is recognized, will be necessary, some formula or curve giving the minimum desirable increments for impact to form the basis for calculation of stress in the immediate future."

All the tests were made with a Fereday-Palmer photographic stress recorder, an instrument in which the compression of the gage length tilts a small mirror and changes the position of a small spot of light reflected from a lamp upon a photographic film. This film is moved by a hand winder, under control of a speed-changing transmission, intended to make it possible to adapt the various lengths of record to the available film length (about 20 inches; the instrument uses a standard six-exposure film for 2¼ x 3¼-in. camera). A shutter in the path of a second beam of light is moved by clockwork so as to cover and uncover alternately the film on the datum line, breaking it up into lines and spaces each one-quarter second long. This gives not only a datum line for the strain

curve but also a time scale (see the specimen records, Fig. 1).

Major Mount states that the instrument was found subject to a certain amount of datum-line error, probably due to slip of the gage points on the member. The frequency of the instrument was found to be 200 to 300 vibrations per second. Certain types of trough flooring and stringers had equally high frequency; the records in those cases were not reliable. Attempts were made to increase the frequency of the instrument by applying a stiffer spring to the moving mirror, but the desired effect was not obtained. By clamping the instrument more tightly to the member under test, however, the frequency was increased to about 350.

Of the 362 records obtained on 20 bridges (the work was done on eight Sundays in the period from July

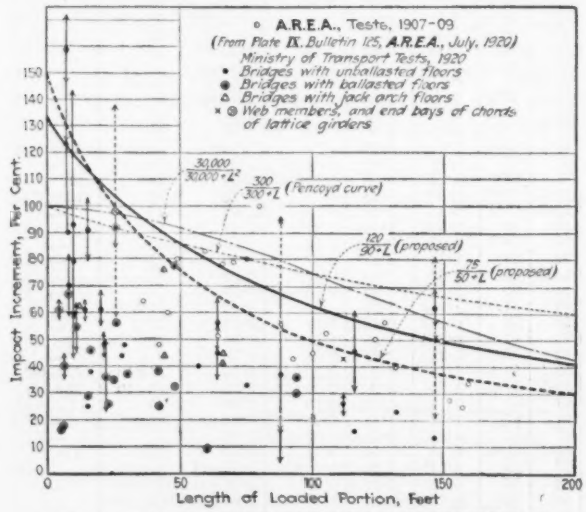


FIG. 2. IMPACT TEST RESULTS AND FORMULAS

to October, 1920) some records are reproduced herewith, selected from a large number given in the report. The structures selected for test were steel bridges, "as far as possible typical of British practice"; they ranged in span from 15 ft. to 146 ft. 8 in., and in type from simple longitudinal troughing to two-girder and three-girder structures (both plate-girder and shallow truss). Floor types included open, ballasted and jack-arch. "Special attention was given to testing floor members and spans under 40 ft., to which less importance was attached in the experiments carried out by the American Railway Engineering Association."

Test trains were made up of one or two locomotives and a dynamometer or other car. "The engines were of typical two-cylinder passenger type, chosen from approximately the heaviest working on each system. Speeds from zero (or crawling) up to a normal maximum of 55 to 65 miles per hour were used, but in one case the speed was run up to 84 miles per hour."

The ordinate scale of all the records was 0.1 in. to 2,240 lb. per square inch.

In determining and reading records, which was done with dividers and an ivory scale, readings checking 0.005 in., allowance had to be made for the datum error, that is the difference between stress-line ordinates at beginning and end of a record. Half of the datum error was taken as a measure of the reliability of the result, and this figure (converted to impact percentage) is given in the tabulated results as a plus-or-minus addendum following each result. Where less than 0.05 ton (2,240-lb. ton) per square inch it was neglected.

Features of the Results.—The recorded stress at crawling speed, considered as the static stress due to live load, was found to be in nearly every case *less than the calculated* live-load stress for the weight of the test train. The report suggests that this is due to neglecting the partial continuity of the stringers, to the deduction for rivet holes, to the omission of web and sometimes part of the flange in calculating moments in plate-girders, to the co-operation of floor system and bottom laterals with the chord, to the relief of main stress occasioned by the secondary stresses (distortion stresses), and, in the case of jack-arch floors, to assistance of the steelwork by the masonry.

Aside from the instrumental vibrations, which were ignored in reading the records, "some of the records, particularly those of larger spans, show high-frequency vibrations," ranging in frequency from about 30 to 70 per second. "They are much slower than those due to the instrument, and faster than those due to the girder as a whole," and they are considered to represent definite variations in stress in the member. These vibrations appeared in records of bottom-flange stress, but were generally less evident in corresponding records from the top flanges. In some records it was possible to measure the amount of this vibrational stress, which the report calls "secondary stress"; and the results of these measurements are given in the last two columns of the table of results, p. 643.

The measured live-load stresses given in the table are those corresponding to the maximum ordinates, thus including the effects of any high-frequency vibration. If these "secondary stress effects" were omitted in drawing the limiting curve of experimental results (in a diagram like Fig. 2) the curve would follow generally the direction of the Pencoyd curve but would be 40 to 50 per cent lower.

The report says: "It may then be argued that, if allowance for impact should exclude any increment on account of secondary stress, the results of these tests should be held to justify a percentage addition for impact not exceeding, say, 60% of the live load for any length of span. These experiments, however, have not been carried out with the object of exploring the more theoretical side of this controversial problem." It should be noted that the term "secondary stress" in the report refers throughout to the high-frequency vibration and not to what is more commonly called "secondary stress," namely, that due to distortion of a truss under applied load.

After comparing the test results with those computed from the Pencoyd formula, the report says:

"The opinion may at first be formed that there is no marked evidence to justify any decided departure from the Pencoyd formula. It must, however, be borne in mind that higher speeds than those attained in the experiments (say up to 75 m.p.h.) are not uncommon with express traffic. At the same time, as this speed is below the critical speed for short spans, greater impact effect than that recorded is quite likely to result under ordinary running conditions. Moreover, no steps have been purposely taken in these tests to locate engine driving wheels in their worst positions, so it is improbable, for this reason also, that maximum results have, in any case, been attained. In regard to longer spans, the results certainly indicate that the Pencoyd

allowance is excessive, provided that, as already explained, comparatively high secondary stress effect is not taken into account. Although in the case of trough flooring, high impact percentages were not measured, we have, in view of the above considerations, indications that for floor members and short spans the Pencoyd formula does not provide an adequate allowance. It will be of interest to note that high results were, in certain cases, obtained on ballasted bridges, and it does not appear therefore, at the moment, to be advisable to make special concession in respect of this type."

Two formulas devised by the subcommittee are shown on their plot of results, Fig. 2 on the preceding page. The first, represented by a dash line, is $I = 75/(L + 50)$, giving a maximum of 150 per cent increment. "This," says the subcommittee, "may be deemed a little too high, and moreover the curve does not cover the maximum results of the A.R.E.A. in the important neighborhood of 60-ft. spans." The second formula, represented in full-line curve, is $I = 120/(L + 90)$, which gives a maximum increment of 133 per cent. Major Mount concludes, "It includes, to all intents and purposes, the A.R.E.A. results mentioned above. It practically covers the mean of the readings on 7½-ft. rail bearer on the Southeastern and Chatham Ry. bridge No. 134, and if considered as covering only normal secondary stresses, it very amply embraces our results for longer spans. It is the curve which, I think, more nearly represents the results of our tests."

Street Explosions in Electric Conduits

EXPLOSIONS along an electric cable conduit in the center of Minneapolis, Minn., on July 30, last, resulted in blowing off manhole covers and sidewalk lights and breaking many windows. This was a 12-duct conduit carrying the mains of the Minneapolis General Electric Co. The direct-current mains to which the building services were connected were in an adjacent 9-duct conduit and were not affected. Smoke from a manhole at 6th St. and Nicollet Ave. was seen at 10:15 p.m. and in a short time two manhole covers were blown off, followed by an explosion in an areaway which blew a hole in the sidewalk. Later, two other manhole covers were blown off and there was a second areaway explosion. After the explosion there was an odor of illuminating gas at the opening of the first sidewalk explosion, and leaks were found in a 1½-in. gas pipe. An investigation was made by the chief electrical inspector in the building department, the fire marshal and the inspector of outside wiring in the city engineer's department. The report, as abstracted, follows:

Upon digging up the conduits it was apparent that a ground and short circuit had occurred at two places and the cables were damaged between these points. Heat is generated in conductors carrying current and if prevented from escaping it may reach abnormal temperatures. The conduit was an asphaltic compound and had softened either by the heat of the short-circuit or previously due to the heat of the normal current and the long spell of hot weather, thus closing the air space around the cables and shutting off ventilation. The soil was dry and afforded little escape of heat by conduction or radiation. It was found that this duct softened at about 310 deg. F. and gave off a dense yellow smoke at 470 deg. This smoke burned freely in air and when mixed with air in a closed receptacle it exploded on ignition, according to tests made by the city engineer's department. This would indicate that an explosion could happen without the presence of illuminating gas.

The load on the cables was well below their safe carrying capacity and could not furnish enough heat to generate gas in the conduit, but an electric arc caused by a ground and short circuit could easily heat the duct to such a point. Recording instruments show that the first serious short-circuit occurred at 10:11 p.m. on July 30.

Recommendations — (1) All service tubes and conduits entering buildings and sidewalk areas from underground manholes should be sealed at the entrance to the building so as to prevent passage of gas between the manholes and buildings; (2) the type of 12-duct conduit which failed should be replaced by single-duct approved conduits separated by concrete so that a burnout in one will not spread to adjacent cables; (3) the duct space should provide at least 25 per cent of unused conduit for ventilation; (4) manholes should be ventilated and have covers so made as to prevent them from baing blow into the air in case of explosion; (5) fire department underground circuits should be carried in municipal cables in conduits, but not in the same conduits with lighting or power cables.

Stone Carriers Supplant Cableway

IN THE construction of the Marikanave dam in Mysore State, India, an aerial cableway was erected to bring the stone from the quarry to the dam site. According to E. W. D. Slater, who lives in that state, the

"NOWGUNNIES"—UNIONIZED STONE CARRIERS OF INDIA

engineers soon found that it was cheaper to deliver the stone on the work by human means; that is, by utilizing the local craft known as "nowgunnies." These men are professional stone carriers who work in gangs of fifteen, twelve, eight, four, and two, and carry from 70 to 150 lb. per man, working 10 hr. per day for 8 annas, which is 16c. today. The stone are suspended on chains attached to bamboo sticks which are carried on the shoulders of the men as shown in the accompanying view. Ninety per cent of the stone on this dam was carried by gangs of four, for which two men tracking each other carried long bamboo sticks on their shoulders with cross bamboo sticks suspended in the middle by chains with the stone suspended from the cross stick.

Railway Tracks Removed from Streets of Dallas

Texas City Establishes Belt Line and Takes Main Lines from Streets to Form an Industrial District

REMOVAL of railway main tracks from streets and from private right of way in the city of Dallas, Texas, is an unusual and important feature of a "city planning" program which includes the elimination of grade crossings, the more systematic arrangement of railway facilities and the improvement of city traffic conditions. A considerable part of this program has been carried out, particularly as to the railway work.

This city, with a present population of nearly 160,000, was located originally on the east bank of the Trinity River because the Houston & Texas Central R.R and the Texas & Pacific Ry. happened to cross near there. Since that time six other lines have entered the city, and with the usual unregulated growth of both the city and the railways there developed the undesirable feature of the city being cut into many sections by main line railway tracks.

As a result of this situation the business district expanded as a long narrow stretch and grade crossings were numerous. Some of the crossings were particularly dangerous from the fact that heavy grades called for relatively high speed of trains in order to pull over the summits of grades. Another result was the development of "blighted districts" along the railways, where property which would ordinarily be good for business locations was given over to the cheapest sort of housing, thus constituting an economic loss to both the property owners and the city. To remedy such conditions and to promote the proper development of the city, the municipal authorities in 1910 engaged George E. Kessler, city planning expert, St. Louis, Mo., to prepare a city plan for Dallas.

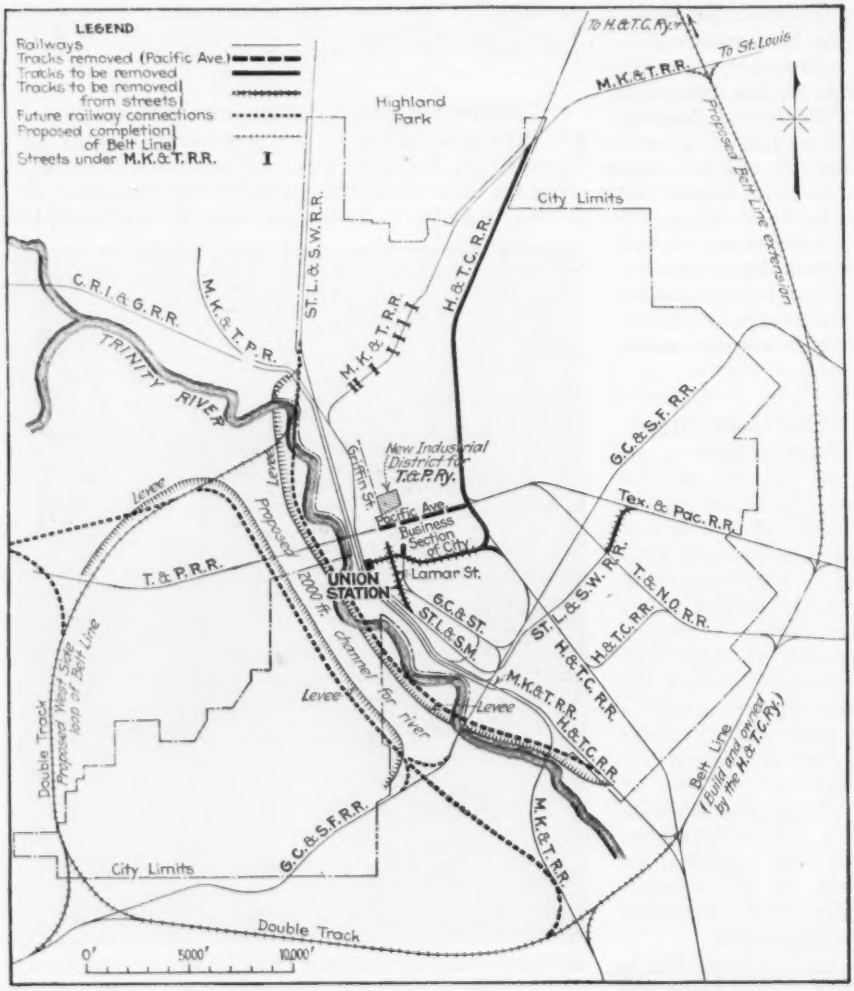


FIG. 1. RAILWAY IMPROVEMENTS AT DALLAS, TEX., INCLUDE RELOCATION OF TRACKS

In regard to the railway situation, Mr. Kessler's report, made in 1911, recommended four important features: (1) A belt railroad in two loops on the east and west sides of the Trinity River, connecting with each other along the bottom lands; (2) a union passenger station on the eastern loop and at the west end of the business district; (3) a freight terminal for local business, located near the passenger station and adjacent to the business district; (4) the elimination of grade crossings in the downtown section of the city.

The union passenger station was the first project carried out, this being done by a company representing all the railways concerned. The station with its approaches cost about $6,500,000 and was opened on Oct. 8, 1916 (see *Engineering News-Record*, June 25, 1914, p. 1415). Next came the separation of grades on the Missouri, Kansas & Texas Ry. along its right of way from the north yard limit to Knox St., 2¼ miles. The railway was elevated slightly and the streets were depressed. This work, which eliminated seven street crossings, was completed in October, 1919, at a cost of $460,000, the city paying for property damages and street paving. The next work was the construction of that part of the new Houston & Texas Central R.R. belt line from the terminal tracks to the Texas & Pacific Ry. main line beyond the city limits, a distance of 2.6 miles. This construction was done at a cost of about $300,000.

Clearing Tracks from Pacific Ave.—The completion of this belt line connection, in the spring of 1921, made it possible to remove the Texas & Pacific Ry. tracks on Pacific Ave. for a distance of 0.67 mile through the

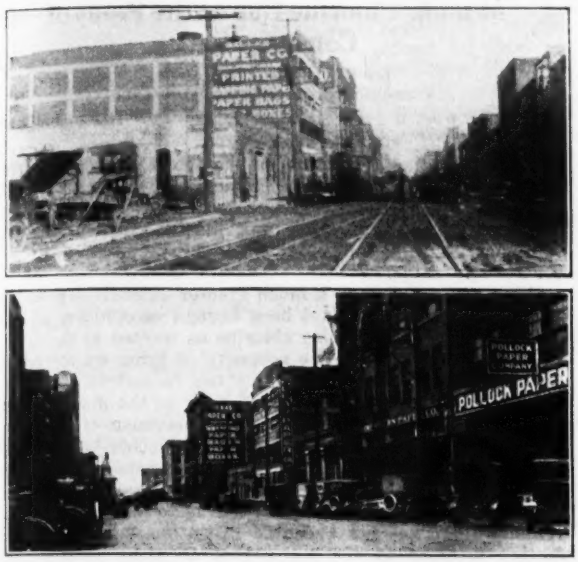


FIG. 2. PACIFIC AVE. BEFORE AND AFTER REMOVAL OF T. & P. RY., DALLAS, TEX.

heart of the city, thus eliminating nine dangerous grade crossings.

Removal of the tracks from Pacific Ave. was an important event which closed a controversy of eleven years. In addition to negotiation with the Texas & Pacific Ry. it necessitated persuading the Gulf, Colorado & Santa Fe Ry. to relinquish its running rights on the Pacific Ave. lines. This case is considered a striking illustration of what may be accomplished through complete co-operation of the railways and the city government, with the backing of public opinion. For several years business interests had hesitated to establish themselves beyond Pacific Ave., on account of the railway obstruction and the consequent poor condition of the property, in spite of the fact that the growth of the city was in this direction. With the 80-ft. thoroughfare clear of tracks there is oportunity for developing a high class business street. Fig. 2 shows the condition of this street with and without the railway tracks.

The railway company had a long term franchise on Pacific Ave. which it gave up in exchange for rights of way in a new industrial district. All details of the project were handled by the Wholesale District Trackage Co., composed of a committee of business men. They raised approximately $534,000 to purchase rights of way in the district bounded by Lamar, McKinney and Orange Sts. and Ross Ave., which is to be developed by the Texas & Pacific Ry. as an industrial district. In addition to this, the railway had an old passenger station at Lamar St. and Pacific Ave. which was purchased from the Trackage company by the city for $166,000. This was the only amount paid by the city. The rights of way in the industrial district were then given to the railway in return for the abandonment of its franchise rights on Pacific Ave. and the complete removal of its tracks. A stretch of the Texas & Pacific Ry. track north of the union station is left unchanged (see Fig. 1) because it forms the lead into the new industrial district and also because it is not desired to remove trackage west of Lamar St.

Other Track Removal Projects.—Several other problems involving track removal have been given encouragement by the success of the Pacific Ave. project. Chief among the problems now under consideration are the following: (1) Removal of the Houston & Texas Central R.R. main line on its private right of way from Williams St. to its intersection with the Missouri, Kansas & Texas Ry., near Highland Park, about 3.75 miles; (2) removal of the St. Louis Southwestern Ry. tracks from Lamar St. (0.47 mile) and from Parry Ave. (0.50-mile). These three changes would eliminate 37 grade crossings and permit rational expansion of the city.

The Houston & Texas Ry. project differs from the others mentioned in that the railway is on its own right of way, but entire removal of the line is considered preferable for the city's interests, rather than elevation of the tracks simply to eliminate grade crossings. A committee is now working on this project and will offer rights of way in an industrial district in exchange

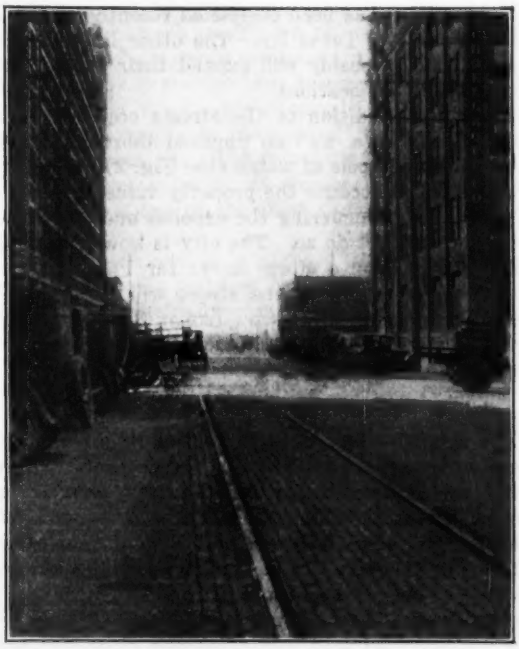


FIG. 3. PAVED MAIN TRACK ON LAMAR STREET (TRACK TO BE REMOVED)

for abandonment of the present right of way. It is proposed to transform the 50-ft. right of way and an acquired strip 150 ft. wide into a 200-ft. boulevard between the business district and North Dallas. The benefit to the city and the adjacent property owners would be in the increased value of this property, as the section of the city traversed by the railway is now of low value and is either vacant or occupied by cheap housing.

Removal of the St. Louis Southwestern Ry. tracks on Lamar St. would release a thoroughfare on the western boundary of the business section which has been designated as part of a system of belt trafficways. It would also promote the opening up of a section which is considered ideal for industrial development but which has not been developed on account of inaccessibility and railway obstruction. These tracks originally formed the approach to the company's old passenger terminal, but since the opening of the Union Station they are used but little, except as team tracks.

On Parry Ave., a residence street 50 to 100 ft. wide fronting the Texas State Fair Grounds, the St. Louis

Southwestern Ry. has a single track connecting with the Texas & Pacific Ry. But with the completion of the Belt Line this connection has become unnecessary. Its removal will release a street needed for vehicle traffic and will increase property valuations considerably.

Industries and Freight Stations.—Industry tracks served by the abandoned lines were not provided for in the change, but most of the industries are moving to other locations and others are using trucks. With the removal of the Houston & Texas Central line north of Williams St. the lines of the Texas & Pacific Ry. and the Texas & New Orleans Ry. which now connect with the former (see Fig. 1) will lose their through connection but will continue to be used as industry lines.

The union freight station proposed by Mr. Kessler has not been built, but new freight terminal facilities are expected to be provided by individual railways when they are able to undertake these improvements. A new freight station has been completed recently by the Missouri, Kansas & Texas Ry. The other lines are badly cramped and probably will expand their present facilities or seek new locations.

As to the condition of the streets occupied by railways, Pacific Ave. was an unpaved thoroughfare with ruts, holes and pools of water (see Fig. 2). This street was not paved because the property values did not justify the city in incurring the expense and the property owners would not do so. The city is now preparing to spend $300,000 on a storm sewer for Pacific Ave. and when this is completed the street will be paved. On the other hand conditions on Lamar St. warranted its paving, as shown in Fig. 3, brick being used along the track and asphalt at the sides.

Track Removal and Track Elevation

The agitation for grade separation or elimination of grade crossings at Dallas, Tex., reached its climax in 1914, when amendments to the city charter were adopted giving the city authority to require such elimination. The administration which went into office in the spring of 1915 was pledged to take the necessary action. Removal of the tracks and rearrangement of the railways in preference to elevation of the tracks on their existing locations was adopted on the recommendations of both Mr. Kessler and the late John Findley Wallace, consulting engineer, who was called in by the city to investigate the situation. The following is an extract from Mr. Wallace's report, made Nov. 22, 1915:

> It is possible to bring about the elimination of grade crossings by the elevation of the tracks of the several railroads by the expenditure on the part of the railroads of not to exceed $5,000,000. To protect all of the existing grade crossings by watchmen, gates and bells would require an annual expenditure that would represent a capitalized value of about $3,200,000. The construction of a belt line with adequate interchange and terminal facilities for the joint use of the railroads of Dallas would eliminate the necessity for general track elevation and would cost approximately $900,000, including the double tracking and grade separation of a portion of the Missouri, Kansas & Texas Ry. The removal of most of the tracks within the more central portions of the city and the taking over of the rights of way by the city as a part of the street system would be a desirable accomplishment.

These railway and municipal improvements have been promoted and assisted largely by the Chamber of Commerce Metropolitan Development Association, of which Charles Saville is general manager; E. A. Wood, engineer, and George E. Kessler, city planning consultant.

Making Chlorine Gas at the Point of Consumption

By Clarence W. March
Consulting Engineer, New York City

Extracts from a paper read before the New England Water Works Association, September, 1921.

WHY not make chlorine on the job? This is the best and most efficient way because the chlorine is made as a gas under atmospheric pressure or less and is immediately available for use and in the exact proportion to the dosage and water pumped without the need of further control apparatus.

Why is it not done to a much greater extent? Up to the present time there has not been enough recognition of the basic economy of producing chlorine as wanted at the point of consumption without the necessity of tying up money in inventories, in shipments and at the factories. There is not enough knowledge of various steps in the manufacture and distribution of chlorine in the possession of the consumer. Manufacturers of bleach and chlorine have shown commendable zeal in the sale of their products and have helped the consumer by placing in his hands excellent devices for the control and dosage of chlorine to water, but until recently there has not appeared in the market an efficient enough machine at reasonable cost to make feasible the manufacture of chlorine in small quantities by the small consumer.

Recently there has been developed an electrolytic cell battery which takes very little space and is a unit, not several units, which means few parts and a very low cost of repairs, renewals and depreciation. In addition, the efficiency with which the power is used makes the cost of producing chlorine 20 per cent less than present methods and cuts the waste of materials used in cells to less than one-half that which formerly seemed necessary. It places a more efficient machine in the hands of the small consumer than the largest manufacturers of chlorine use today.

[The author then gave somewhat detailed comparative estimates of the cost of bleach, liquid chlorine and chlorine gas at the place of use, and pointed out the various advantages of the latter, as he sees them. Stress was laid on the small size of the cells and the fact that they can be placed in the laboratory of a small water-works. Finally, the author described an average installation to produce 50 lb. of chlorine daily, consisting of three working and one spare cells, as follows.—Editor.]

Each of these cells will produce 17 lb. of chlorine daily at a rate of approximately 1⅛ kw.-hr. (a.c.) per lb. of chlorine or 1¼ kw.-hr. (d.c.) after transformation of current per pound of chlorine at the switchboard. The current used will be 260 amperes at 2.8 volts per cell or 8.4 volts at the cells for the battery of three cells. This is for a period of six months. The cells are approximately 2½ ft. long x 10 in. wide x 2½ ft. high.

The cells consist of three parts. The concrete top, which may be suspended from above and to which is attached perforated and horizontally corrugated steel plates, carrying in turn several sheets of asbestos paper conforming in shape to the steel plates. The steel plates are the cathodes and the asbestos paper is the diaphragm. The anodes of Acheson graphite are suspended from the top and are enclosed by the steel plates which form the compartment for receiving the brine solution or electrolyte. With a few fittings, such as the copper conductors, the automatic brine-feed floats, the gage glasses for determining the height of the brine in the cell, and the chlorine outlet from the top of the cell, the cell is complete. The top is solid except for the openings for the anode, float and the chlorine outlet, which are sealed tight against leakage of gas.

There are no expensive parts to the cell. The top is a concrete casting of small dimensions and will last five years or longer. It is subject to no stress because it is not restrained in any direction. It can be readily replaced at very small cost. The cathodes are sheets of corrugated steel which last not less than five years. The anodes are the most expensive but weigh only about 85 lb. for the above type. They last two years without replacement. The mate-

rial is of the cheapest form. Cylinders 1¾ in. to 2 in. in diameter and 2 ft. long and a post rectangular in shape and approximately 2½ ft. long, all pinned together with graphite pins. The fittings are glass, rubber and lead—all standard commercial forms and cheap.

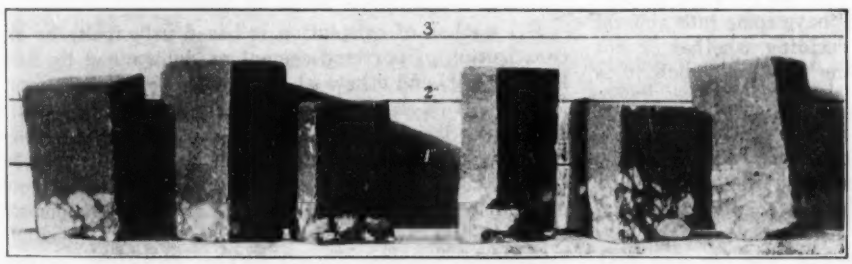
Discussion—Frank W. Green, superintendent of filtration Montclair and East Jersey Water Companies, Little Falls, N. J., said that his plant is one of four that has made its own chlorine for some years past [the other three being the private plant at Montreal and the city plants at Trenton, N. J., and Omaha, Neb.] The cost of local manufacture at Little Falls is 1½c. against 8½c. per unit for liquid chlorine, but with no allowance for power at Little Falls. An old Nelson cell is used at Little Falls, which, Mr. Green said, is not so good as the Marsh cell.

Thin Binder Course a Menace to Asphalt Pavement

Tendency on the Part of Engineers to Specify Depth of 1 Inch or Less Is Proving a False Economy

By Roy M. Green
Manager, Western Laboratories, Lincoln, Neb.

During the last three years there has been an increasing tendency in asphalt paving practice to use binder courses only 1 in. thick, in order to reduce costs. In the construction of the earlier pavements the use of 1½ and 2 in. of binder was considered good practice, the 2-in. depth being regarded as the best. The present tendency to decrease the depth of the binder course is shown by the fact that 34 per cent of the specifications for sheet asphalt for 1920 from 42 states and municipalities widely distributed over the United States call for a depth of 1 in., 49 per cent for 1½ in., 3 per cent for 1¼ in., 2 per cent for no binder course at all and 12 per cent for a binder depth "shown on the plans." In other words, of the specifications which indicated the depth to which the binder was to be laid, approximately 40 per cent required that it be 1 in.



VARIATIONS IN BINDER DEPTH OF ASPHALT PAVEMENT IN FORT WORTH, TEX.

In the construction of a sheet asphalt pavement there are three reasons for which it is desirable to lay a binder course. First, to even up depressions and irregularities in the foundation so that a uniform thickness of the wearing surface may be laid. Second, to bind the wearing surface to a stable combination and thus reduce the possibility of waves being formed by traffic. Third, to assist in preventing cracks formed in the rigid foundation from being transmitted through the wearing surface.

When the concrete foundation is completed and ready to receive the wearing surface it is always slightly irregular in cross-section. If a fine bituminous mixture were laid upon this irregular surface and rolled all the irregularities of the base would be apparent at the surface. Due to the poorer compaction of the wearing surface above the low spots in the base and the resulting porosity the surface would continue to become more wavy with usage. When a binder course is laid upon such a foundation a surface true to the finished cross-section and parallel with it should be produced, so that the wearing surface may be laid to a uniform depth. This is one of the important functions of the binder course.

Bituminous wearing surfaces laid directly upon concrete foundations do not become attached to them, as is shown when such surfaces are torn up. Under such conditions there is generally a movement between the wearing surface and the concrete base. To prevent such motion of the wearing surface along the base a stable mixture of binder is interposed. With a binder course, then, the concrete foundation simply acts as a support to the pavement, the binder furnishing a stable medium to which the plastic wearing surface mixture may attach itself. To be successful the binder course must be a dense combination laid to a sufficient depth so that it may possess maximum stability.

Foundation cracks are transmitted to the surface much more readily in pavements that have no binder course between the rigid foundation and wearing surface. The reduction of the number of these cracks in the surface is one of the chief functions of the binder course.

If the binder course is to meet these requirements it must be properly prepared and laid to a thickness such that it may effectually even up all irregularities of the concrete base without being so thin in places that its stability is sacrificed. If the average thickness of the binder is only 1 in. there will be many places that have a thickness of only ¾ in. The illustration shows several cross-sections selected at random from the streets of Fort Worth, Texas, where 1-in. binder has been used. It shows the variation which may be expected in the depth of the binder course due to irregularities existing in the base.

Since it is considered the best practice to construct binder with stone having a maximum size three-fourths the depth of the course, a 1-in. binder should be made of a stone ¾ in. in maximum size. When constructed of stone of such a size there will be places where the ¾-in. stone will be exposed at both the upper and lower surfaces of the binder course. When the course is being rolled many of these will become shattered. Under such conditions it is impossible to expect any great amount of stability to result from the course nor will it be of any great assistance in reducing the number of foundation cracks from being transmitted through the top surface.

Many more sheet asphalt pavements that fail are failures on account of waviness rather than because the top surface is worn away by traffic, thereby exposing the binder. If it is desirable to produce a cheaper pavement it is much better to reduce the depth of wearing surface than the binder, the minimum thickness of which should be 1½ in. This will result in greater economy, as the wearing surface is always by far the more expensive.

Interpreting the Chemical Analysis of Portland Cement

Suggested System of Recasting Has Not Demonstrated Relationship of Such Results With Physical Behavior

By J. C. Witt

Structural Materials Research Laboratory (Co-operation Portland Cement Association and Lewis Institute), Chicago, Ill.

IT IS the purpose of this paper to discuss some of the tests that may be applied to a given sample of portland cement to determine its value as a material of construction. We are to consider the sample as representing a finished product, and the information that may be gained concerning it by applying tests, without presuming any detailed knowledge of the raw materials or the operation of the particular plant in which it was produced. That is, the statements made herein are applied to the testing of finished cement, and not to plant control nor research.

The limitations of chemical analytical methods have been in a measure taken for granted, and comparatively little discussion has found its way into the literature for some time past. The general opinion has been that the results of a complete chemical analysis add little to the information that may be obtained from a series of physical tests and often magnesia, sulphuric anhydride, loss on ignition, and insoluble matter are the only chemical determinations made. It is obvious that the composition of a cement is of the highest importance and is the determining factor of its quality. However, the nature of the material is such that comparatively little is revealed by the chemical analysis, though if the quality is not satisfactory, it will show up in one or more of the physical tests. Irregularities in composition that cannot be detected by chemical means may have a marked effect on the physical properties, and therefore physical tests have come into general use as the principal basis for deciding whether or not a cement is satisfactory for the use for which it is required.

Processes During Clinkering

The reason for this lack of relationship between the chemical analytical results and the true composition may be understood if we consider the changes that take place in the raw mixture as it passes through the kiln and is formed into cement clinker. The burning may be divided into three periods. These are not sharply divided, but gradually merge one into the other. During the first period, moisture and organic matter are expelled. During the second, the calcium carbonate is decomposed, the carbon dioxide being expelled, while the calcium oxide remains behind. During the third the calcium oxide unites with other substances present, the principal ones of which are silica and alumina, to form the mixture of chemical compounds which constitute cement clinker. The progress of the process during the first and second periods may be readily traced by chemical analyses. Successive samples taken from the upper to the lower end of the kiln show a progressive decrease in the percentage of moisture and carbon dioxide, and a corresponding increase in the percentage of calcium oxide and most of the other compounds present.[1]

After the beginning of the third period, practically no further appreciable change is revealed by chemical analysis. Volatile substances have been volatilized and the chemical changes taking place do not involve any change in the proportion of the elements present. However, if successive samples are taken during this third period and subjected to physical tests, it will be found that they vary all the way from worthless material to cement of satisfactory quality. Assuming, therefore, that a properly proportioned and ground raw mixture enters the kiln, the quality of the resulting clinker is dependent on the last period of the burning process. The first two periods are simply preparatory for the third or most important period.

Recently R. J. Colony[2] has reopened the question of the value of chemical anaylses in judging the quality of cement. He states that " . . . some additional mode of determining the quality of cement must be employed. The problem is to find a simple, usable, easily applied method that will supplement the standard tests. The solution of this problem involves a knowledge of the chemical composition of portland cements, also of their constitution (or componental composition), as the behavior of a cement, when gaged, is dependent on the physical and chemical characters of the compounds of which it is composed, the proportions existing between them, and the fineness of grinding. It is likewise essential to know the character, behavior and composition of the hydration products of portland cement.

As the components of portland cement have a definite composition, the various oxides found by chemical analysis must be uniformly distributed and united with one another according to fixed laws of chemical combination. Hence it should be possible to recast an analysis in much the same manner as rock analyses, and to obtain the percentage composition of the cement in terms of the actual compounds, instead of the oxides of the elements forming the mass."

Components of Cement

His method of calculation is based principally on the constitution of portland cement as determined by Rankin, Wright, and others at the Geophysical Laboratory. Work in this field has also been carried on at the Bureau of Standards and elsewhere. According to these investigators the principal components of portland cement are a series of calcium oxide and silica compounds, and calcium oxide and alumina compounds. Over 90 per cent consists of the three compounds, tricalcium silicate ($3CaO.SiO_2$), dicalcium silicate ($2CaO.SiO_2$), and tricalcium aluminate ($3CaO.Al_2O_3$). Colony proposes to calculate the amount of each of these three components from the chemical analysis. The carbon dioxide, sulphuric anhydride, ferric oxide, and alumina are calculated to the corresponding calcium compounds. The remaining calcium oxide (which we shall designate as the *net* calcium oxide) is then applied to the total silica, and by means of simultaneous equations the amounts of tricalcium silicate and dicalcium silicate are calculated.

It is possible to determine the approximate proportion of the components of a cement by use of the petrographic microscope, and the chemical analysis of the material may be of some service in this connection. However, in this case, the real information comes from the petrographic examination, and the chemical analysis is only auxiliary, and may be dispensed with entirely.

In order to make clear the comments of the writer on this proposed system of calculating results (as he

understands it), the various steps are indicated in the form of equations. For each compound to be considered, let P = the percentage, and W = its molecular weight. Then, starting with the value determined by analysis in each case, we have

Carbon dioxide to calcium carbonate:

$$P_{CO_2} \frac{W_{CaCO_3}}{W_{CO_2}} = P_{CaCO_3} \quad (1)$$

In the same manner, $P_{CaSO_4.2H_2O}$, $P_{3CaO.Fe_2O_3}$, and $P_{3CaO.Al_2O_3}$ may be obtained.

The *net* calcium oxide, which we may designate as P'_{CaO}, may be calculated by the equation

$$P_{CaO} + P_{CO_2} + P_{SO_3.2H_2O} + P_{Fe_2O_3} + P_{Al_2O_3} - (P_{CaCO_3} + P_{CaSO_4.2H_2O} + P_{3CaO.Fe_2O_3} + P_{CaO.Al_2O_3}) = P'_{CaO} \quad (2)$$

Now, having the net calcium oxide, P'_{CaO}, calculated as indicated, and the total silica, P_{SiO_2}, as determined by analysis, we may calculate the percentages of tricalcium silicate and dicalcium silicate present in the cement by means of simultaneous equations, *assuming that these two compounds (and only these) are present.*

Let x = % tricalcium silicate = $P_{2CaO.SiO_2}$
y = % dicalcium silicate = $P_{3CaO.SiO_2}$
a = % net calcium oxide = P'_{CaO}
b = % silica = P_{SiO_2}

m = the ratio, $\frac{W_{CaO}}{W_{3CaO.SiO_2}}$

n = the ratio, $\frac{W_{CaO}}{W_{2CaO.SiO_2}}$

Then
$$x + y = a + b \quad (3)$$
$$mx + ny = a \quad (4)$$

Solving for x and y,

$$y = \frac{m(a+b) - a}{m - n} \quad (5)$$
$$x = a + b - y \quad (6)$$

Conditions in Ideal Cement

In discussing these equations and the analytical work on which they are based, let us assume two cases:

1.—An "ideal" portland cement made from chemically pure materials. The calcareous and siliceous materials are exactly proportioned, the burning has been continued at sufficiently high temperatures until the maximum amount of tricalcium silicate has been formed. After the clinker has been ground and cooled, the proper amount of chemically pure hydrated calcium sulphate ground to the same fineness has been added, and thoroughly mixed. The sample is then preserved in such a manner that it cannot absorb either water or carbon dioxide.

2.—A commercial portland cement of average quality, which passes all standard specifications.

In an ideal cement there should not be more than a trace of moisture or carbon dioxide present. There should be no difficulty in calculating the percentage of gypsum, tricalcium aluminate, and calcium ferrite—assuming that the formula given for the last is correct. Without going into the details of chemical analytical methods, it may be pointed out that every determination is subject to experimental errors[4] and results obtained by different laboratories do not always agree.[5] When the net calcium oxide is calculated by equation (2), the result is subject to the sum of practically all the analytical errors made in the complete analysis of the sample. It may happen that some of these errors compensate each other, but there is no way of knowing when this occurs and consequently it is not possible to make allowance for this in the calculation. While the error in the result of any one determination might be negligible, or even the algebraic sum of the errors for the complete analysis might be negligible (in some cases), it may be seen that there is always a possibility of a considerable error and the value for the net calcium oxide obtained by this round-about method cannot be considered exact.

In calculating the percentage of tricalcium silicate and dicalcium silicate from the net calcium oxide and the total silica, use is made of what is termed "indirect analysis." In some cases, it is not possible to get complete information by making direct determinations, and in other cases the work is so difficult or so much time is required that direct determinations are not made. It is well understood, however, that such indirect analyses are only approximate[6] and that they should be used as sparingly as possible. The method is sometimes applied to the determination of sodium and potassium. If the weight of sodium chloride plus potassium chloride and the weight of the chlorine combined as chloride, or the weight of the chlorides and the sulphates are known, the sodium and potassium present may be calculated without determining them directly. The difficulty is that small experimental errors cause considerable differences in final results.

The errors that may arise in applying the principle of indirect analysis to calculate the percentage of tricalcium silicate and dicalcium silicate in a cement may be easily demonstrated. By placing first y and then x equal to zero in equations (5) and (6) and then, in each case, solving for b in terms of a, the values for silica which correspond to all tricalcium silicate, and to no tricalcium silicate, respectively, may be calculated. If we assume 45 per cent as the net calcium oxide value, the silica values are 16.2 per cent and 24.2 per cent respectively. Substituting these values in Equation (5) and (6), the first sample shows 61.1 per cent tricalcium silicate and no dicalcium silicate, while the second shows zero tricalcium silicate. That is, in round numbers, a difference of 8 per cent in silica corresponds to a difference of 61 per cent in calculated tricalcium silicate. In other words, in this one part of the system of calculation, an analytical error is multiplied by 7.5, or an error of 0.2 per cent in making the silica determination becomes an error of 1.5 per cent—which could hardly be considered negligible. In the same way, it can be shown that errors in the calculated value for net CaO have a corresponding—though smaller—effect on the final result.

Commercial Portland Cement

A recast analysis of a commercial cement is subject to all the errors just explained and to a number of others. These arise from the impurities in raw materials, differences in the manufacturing process at the various plants, contamination from the grinding machinery and fuel ash, and so on. It must be remembered also that the work on the constitution of cement was carried out with the ternary system, calcium oxide, silica, and alumina. While these constitute more than 90 per cent of an average cement nevertheless the minor constituents are by no means negligible and influence the reactions taking place in the kiln, by acting as fluxes, for example. So many variables are involved that it is impossible to say just how the

reactions known to take place with pure materials are modified under plant conditions.

Indirect analysis will not reveal whether a mixture consists of the two silicates alone, or the two silicates plus free calcium oxide. The fact that the analysis of a cement shows it to occupy a given position on the triangular $CaO - SiO_2 - Al_2O_3$ diagram, does not necessarily indicate its composition in terms of tricalcium silicate, dicalcium silicate and tricalcium aluminate.

Without discussing the merits of petrographic methods, it is evident that the results obtained for tricalcium silicate and dicalcium silicate by the proposed system of recasting chemical analyses are not dependable, because of the many sources of error that exist. Further, the practical value of such results even if accurate, is questionable, since the relation between the silicates and the physical properties of cement has not been fully established.

According to Rankin's paper[7] "Of these constituents, the compound tricalcic silicate is the one which hardens and devlops the greatest strength within a reasonable time. This most important constituent, which is the one formed with the greatest difficulty, makes up only about 30 to 35 per cent of an average normal portland cement. It may be said, therefore, that the essential process for the manufacture of portland cement is the formation of this compound and that any improvement in this process yielding an increased percentage of tricalcic silicate will increase the cementing value of portland cement." However, Bates[8] is of the opinion that ". . . the composition of portland cement should be along lines which would not produce a great preponderance of either silicate. The ideal cement should possibly have an excess of the dicalcium silicate, which would give a not too dense hydrated material, gaining strength at later periods."

Equivalent Weight Ratios

Another recommendation made by Colony is that the ratio of the equivalent weight of the total calcium oxide to the equivalent weight of the total calcium alumina, and ferric oxide, respectively, is to be used as an indication of the quality of the cement. He is of the opinion that the minimum value for this ratio should be set at 2.4. It may be seen by consulting any book on cement manufacture that some such formula is always used for calculating the composition of the raw mixture. It is generally considered that, everything else being equal, the more calcium oxide present in a cement, the higher the strength (assuming proper burning), until the calcium oxide exceeds the equivalent of the other compounds present. In this case the excess of calcium oxide, will tend to make the cement unsound. Therefore, a maximum value for such a ratio is more important than a minimum, but neither should be specified until unmistakable evidence of the relationship has been obtained by comparing a large number of results of physical tests and chemical analyses, by a number of operators. Even then its usefulness is questionable, if physical tests of the cement have shown it to have a satisfactory strength and soundness. There are formulas for calculating the tensile strength of steel from the chemical analysis, and for calculating the calorific value of coal from its analysis. While these are of great value theoretically, we rely on the testing machine and calorimeter for making routine tests on these materials.

In the case of the analyses and physical tests of a number of samples of cement taken at random from the records of this Laboratory, there was no apparent relation of the tensile and compressive strength either to the calculated tricalcium silicate content, or to the calcium oxide ratio.

Summary

The information that may be obtained from the chemical analysis of a cement is limited. The percentage of the various components cannot be determined directly since they contain the same elements in common, and a system of indirect analysis is subject to so many errors that the results obtained are unreliable.

The system for recasting results of chemical analyses has not demonstrated any definite relationship between such results and the behavior of the cement when subjected to physical tests. The system does not give any indication of the degree of burning to which the clinker has been subjected, and it is of no value in showing the proportion of the components of the mix, since this is shown by the ordinary analysis.

The ratio of the calcium oxide to the other principal components may offer some indication of the strength of a cement, but is of little importance since the strength may be determined directly.

References in the article are as follows:

[1]Witt, Concrete (Mill Section), 16, 73 (1920).
[2]Transactions of the American Institute of Mining and Metallurgical Engineers; *Eng. News-Record*, 86, 637 (April 14, 1921).
[3]Cf. Rankin, J. Franklin Inst., 181, 747 (1916).
[4]Cf. Witt, Concrete (Mill Section) 16, 75 (1921).
[5]Cf. Meade, Portland Cement (Second Edition), 18; Grimm, "Tonind. Zeit.," 33, 128 (1909).
[6]Olsen, Quantitative Chemical Analysis (Fifth Edition), 492.
[7]Rankin, loc. cit.
[8]Technologic Paper of the Bureau of Standards, No. 78, page 27.

Electrification of Railways at Large Steel Plants

IN the railway systems of large steel manufacturing plants there is a large field for economy by the introduction of electric traction for the entire system, as distinct from the present occasional use of electric traction for individual sections of the plant. This view was expressed in considerable detail in a paper presented at the recent annual meeting of the Association of Iron and Steel Electrical Engineers, at Chicago, by R. B. Gerhardt, electrical superintendent of the Bethlehem Steel Co. plant at Sparrows Point, Md. A brief abstract of this paper is given below:

Electric locomotives or cars are used to some extent at most steel plants and although this use has been limited to particular pieces of work, such as the handling of hot coke and hot ingots, there is a great benefit over steam operation. The plan now in view is the complete displacement of the steam locomotive and the introduction of the electric locomotive for all transportation and shifting. A contact system is necessary, for although the storage battery engine offers some attractions for yard work, it is not able to withstand so much rough usage as the straight electric machine, its batteries are subject to a high rate of depreciation and the machine must be idle at certain periods of charging or exchanging batteries. A combination machine using both line contact and battery may have considerable advantage over the straight battery engine. Practically all steel plants have a 250-volt direct-current system, and this should be utilized for traction, as the men are familiar with it and the railway load would tend to equalize the load on the power plant.

For the contact system, the third rail would be the most satisfactory, the objection to the overhead wire being the

extended use of locomotive cranes at steel plants. However, the trolley system might prove of advantage for the classification yards. As to safety of the third rail system, it has been in use on blast furnace trestles for many years without a single accident due to contact with the live rail having the usual current of 250 volts.

The under-contact method is preferable to the top contact for safety and convenience, as it is easy to step over the contact rail and there is no danger in stepping on the guard which covers the rail. Gaps up to 40 ft. in length can be left in the rail at road crossings, and when two tracks are parallel the third rails would be placed between them. As to adapting the third rails to complicated track layouts with numerous switches and cross-overs, such difficulties have been overcome successfully at many furnace tracks.

COST OF STEAM AND ELECTRIC OPERATION OF STEEL PLANT RAILWAYS

	Steam	Storage Battery	Third Rail
No. of locomotives	27	27	23
First cost, complete	$850,000	$1,220,000	$1,376,000
Annual operating cost	567,000	438,200	335,100
Annual saving over steam		128,800	231,900
Return on investment		10.5 p.ct.	16.9 p.ct.

For work in buildings and at special places, such as slag dumps, where the third rail is objectionable or prohibited, the engines would be equipped with a 500-ft. cable to be attached to a suitable electrical connection. At furnaces, the third rail would stop at a convenient distance, an idler car being placed between the engine and the ladle car. At scrap yards, where metal is liable to block the track at the foot of the scrap pile, the cars could be poled from an engine on an adjacent track equipped with the third rail. When the plant railway is electrified, the next step would be to convert the locomotive cranes to motor operation, thus reducing their annual operating cost by about 50 per cent.

Comparative cost of steam and electric railways for steel plants is shown in the accompanying table, actual figures being given for steam and estimated figures for electric traction. The operating cost includes fixed charges, locomotive depreciation, fuel or power, repairs, operating labor, cleaning and the supply of coal, water, sand and supplies.

Pump Stop, Water Hammer and Pipe Break Follow Lightning Bolt

LIGHTNING, striking the power line Sept. 20, feeding one of the electrically-driven pumping stations in Minneapolis, threw out the circuit breakers. Two 50-m.g.d. centrifugal pumps, delivering water through a 54-in. steel lock-bar pipe 3 mi. long to the reservoir under 100-lb. pressure stopped suddenly when the current was shut off. The water hammer resulting from the closing of the check valves caused the bursting of the bonnet of a 42-in. valve on a header at the station and the failure of 16 ft. of lock bar on the steel pipe ½ mi. away from the station and at about the same elevation. This double break left the Northeast station temporarily out of service.

Newspaper accounts attributed the damage to the pipe directly to the bolt of lightning, but J. Arthur Jensen, supervisor water-works, reports the foregoing information. Further, he states that temporary repairs made by removing the broken bonnet and closing the opening on the gate body by a temporary plate, permitted starting the pumps the following morning. The break in the steel pipe was by-passed by using a second force main to the reservoir. During the repair the Camden station was in operation at a 20-m.g.d. rate, the additional amount required being made up by reservoir storage.

Repairs to the steel pipe were made by cutting out the opened section and replacing it with a heavier piece of riveted pipe.

Cleveland Reverts to Asphalt Filler for Brick Pavements

By Fred R. Williams
Paving Engineer Cleveland, Ohio

ASPHALT filler for brick pavement in Cleveland, Ohio, was used this year for the first time since 1905 on sections of Lake Shore Boulevard and Arlington Ave., where a 7-in. concrete base was employed. The city has approximately 7,000,000 sq.yd. of brick pavement in service, built cumulatively since 1887. A large part of this yardage is cement-grout filled and is laid without other foundation than the natural sand of the old lake bed which underlies the city.

In 1913 Cleveland laid its first semi-monolithic brick pavement and a year later began the construction of monolithic brick. The latter type has, in recent years, where cement filler is desired, given place almost entirely to a pavement on a slag cushion with concrete base, approximating the semi-monolithic type.

That the city now turns to the construction of important sections of asphalt-filled brick pavement is due to confidence in the type and belief that a higher quality of asphalt filler is available than that which could have been obtained in earlier years. By virtue of this filler, promise is afforded for the repetition of the service-life which has characterized the older brick pavements of the city, some of which are more than 25 years old.

In addition to carrying heavy through traffic the newly paved section of the boulevard, lying alongside the city's principal lake-front pleasure resort, is called upon to bear the extra traffic of thousands who visit the park in automobiles during the summer months. This accounts for the heavy construction. The filler used was specially made for the city according to the specifications of the National Paving Brick Manufacturers' Association. It was applied at a temperature from 350 to 375 deg. F., and immediately squeegeed into the joints, leaving a minimum of excess filler on the surface of the brick.

The filler specification follows:

Description — Asphalt filler shall be homogeneous, free from water and shall not foam when heated to 200 deg. C. It shall meet the following requirements:

Flash Point—Not less than 200 deg. C. (392 deg. F.).

Melting Point—(Ring and ball) not less than 65 deg. C. (149 deg. F.).

Penetration—At 0 deg. C. (32 deg. F.) 200 gm., 1 min., not less than 10. At 25 deg. C. (77 deg. F.) 100 gm., 5 sec., 30 to 50. At 46 deg. C. (115 deg. F.) 50 gm., 5 sec., not more than 110.

Loss on Evaporation — 163 deg. C. (325 deg. F.) 5 hr., less than 1.0 per cent.

Ductility—Not less than 3.

Total Bitumen — Soluble in carbon disulphide, not less than 99 per cent.

Percent of Total Bitumen — Soluble in carbon tetrachloride, not less than 99 per cent.

Reduction in Penetration — At 25 deg. C. (77 deg. F.) due to heating specified under "Loss of Evaporation," not more than 50 per cent.

Snow Melted in Turntable Pits

In clearing snow at engine terminals the Canadian National Railways have had very satisfactory results from the use of steam coils in turntable pits. This not only facilitates the operation of the turntable but enables the pit to be used as a snow melter, into which is thrown the snow cleared from the yard and tracks, the water being carried off by the drains.

Enlargement of the Sewage-Works of Baltimore

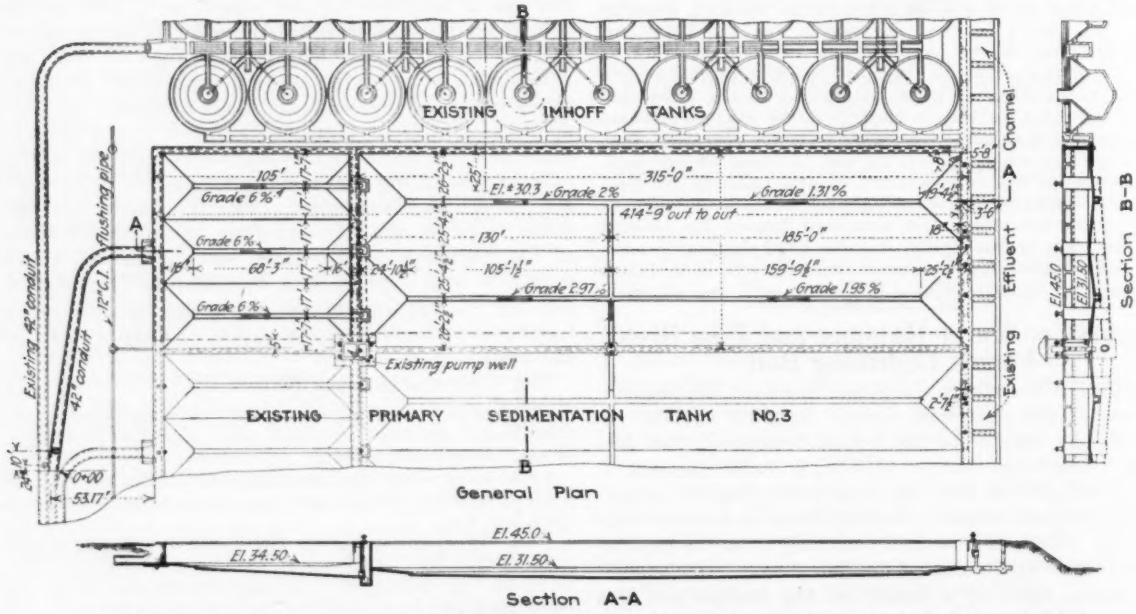
After Experience with Primary Sedimentation Followed by Separate Sludge Digestion and with Imhoff Tanks City Adopts the Former for Extensions—New Unit Described

By C. Edward Keefer
Assistant Designing Engineer, Sewer Division, Baltimore, Md.

SINCE the last extensions to the Baltimore sewage-works were completed in 1916 about 10,000 buildings have been connected to the sewers. To meet the added volume of sewage, a primary sedimentation tank, a sludge digestion tank and a small pumping station are being built. In November, 1920, a loan of $26,000,000 was voted for public improvements, $8,000,000 of which will be used to extend the sewerage system into the unsewered areas of the original city and into a portion of the 59.7 sq.mi. of territory annexed in 1918. The sewage from all of this annexed territory will flow through the existing outfall sewer to the treatment plant except that from a section which is separated from the city proper by the Patapsco River for which another sewage-works will be built. As additional sewers are built in the city the flow will increase, and provision will have to be made to treat it by the expenditure of large sums of money for extensions to the plant. These extensions will consist of primary sedimentation tanks (until recently called hydrolytic tanks), sludge digestion tanks, a meter house, trickling filter beds, sludge drying beds, a workshop and storage building, together with the necessary conduits, pumps, pipe lines, comfort stations, roads, etc.

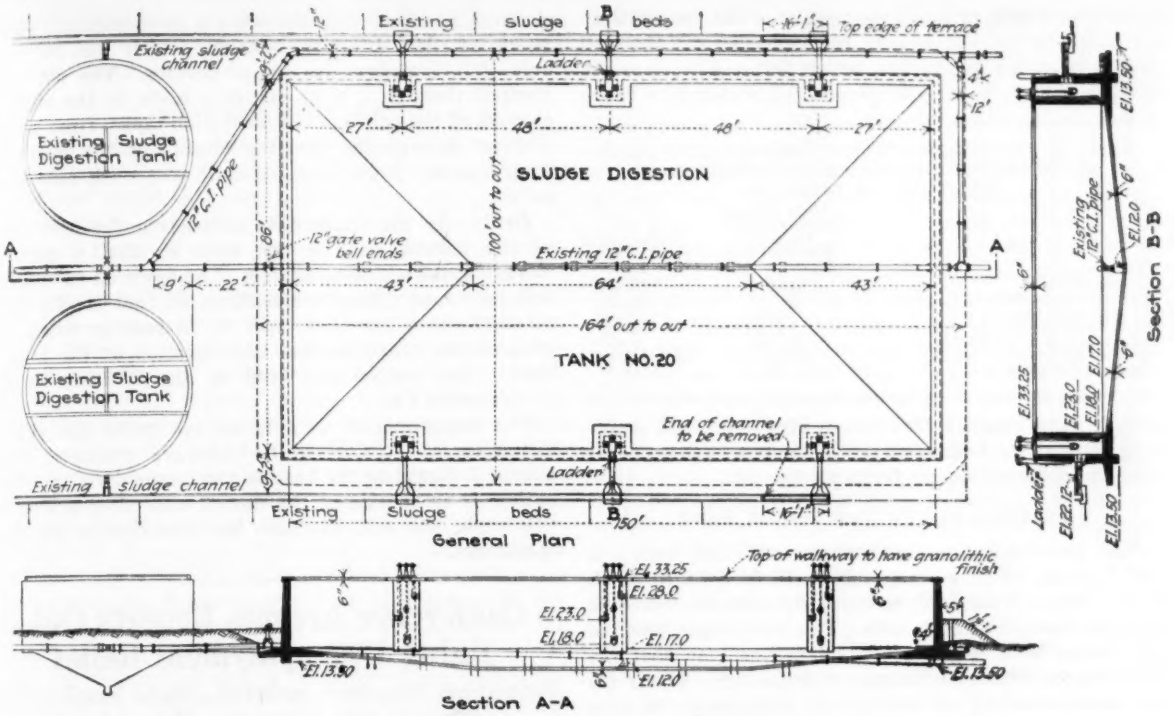
Before designing the new sedimentation tank, much thought was given to the advisability of building in place of it one or more Imhoff tanks. As both kinds of tanks have been in service at this plant, it has been possible to get comparatively low figures. [See "Nine Years' Operation of the Baltimore Sewage-Works," by Theodore C. Schaetzle, principal sanitary chemist in *Engineering News-Record*, July 14, 1921, p. 50—Editor.] Everything points to the adoption of sedimentation tanks in conjunction with sludge digestion tanks as the most logical solution of the problem for Baltimore conditions.

None of the many troubles that have to be confronted in the operation of Imhoff tanks are found in treating sewage with sedimentation and sludge digestion tanks. No foaming is met with; no time is spent squeegeeing; no scum has too be removed; no skimming of the tanks is required; and no uncertainties of operation have to be considered. The settled sewage from the sedimentation tanks compares favorably with that from the Inhoff tanks (see Table I). The digested sludge from the sludge digestion tanks and the Imhoff tanks are practically identical and one dries as quickly as the other on sludge beds. The interest and depreciation on the sedimentation and sludge tanks is less per million gallons of sewage treated (see Table II) than on the Imhoff tanks, and the operating costs at Baltimore per million gallons for treating the same kind of sewage through the sedimentation tanks, sludge digestion tanks and trickling filters is 53 per cent of what it is when the Imhoff tanks and trickling filters are used.



PLAN AND SECTIONS OF PRIMARY SEDIMENTATION TANK FOR THE BALTIMORE SEWAGE-WORKS

The primary sedimentation tank is 420 ft. long and 103 ft. 2 in. wide, with a capacity of 3,800,000 gal. to the flow line. It is divided into two compartments by a baffle wall 5 ft. high at the outer wall of the tank. The compartment into which the sewage enters is 105 ft. long and has a depth varying from 10½ to 12½ ft. The other compartment is 315 ft. long and from 13½ to 15½ ft. deep. In the smaller compart-



PLAN AND SECTIONS OF SLUDGE DIGESTION TANK

ment there are three U-shaped channels that lead to an egg-shaped drain, which in turn empties into a pump well. In the larger compartment there is also a system of "U" channels.

Normally, to get the best results, the tank should be kept in continuous operation from ten days to three weeks in summer, and about six weeks in winter.

TABLE I. COMPARATIVE AVERAGE RESULTS IN 1916 FROM BALTIMORE PRIMARY SEDIMENTATION AND IMHOFF TANKS

	Parts per Million		
		Effluent From	
	Raw Sewage	Primary Sedimentation Tanks	Imhoff Tanks
Settling solids	102	35	26
Biochemical oxygen demand	91	158	132
Total bacteria	1,100,000	800,000	550,000
Acid-forming bacteria	89,000	94,000	100,000

After this period it should be cleaned by opening the two 12-in. sluice gates which connect with the pump well. The sewage runs into this well, and is lifted by a 12-in. open impeller pump into one of the other sedimentation tanks in operation. Next, the sludge, which is often 4 or 5 ft. deep, is broken up by a stream from a ¾-in. nozzle, delivered under a pressure of 45 lb. per sq.in. Enough water is added to make the sludge flow through the "U" channels and the egg-shaped drain to the pump, which removes it to one of the sludge digestion tanks. The grades of the "U" channels vary from 1.31 to 6 per cent, and the grade of the floor from 8 to 8.2 per cent. As it wil be necessary for the man who flushes out the sludge to get into the tank, it was decided not to give the bottom a steeper grade. Previous experience has demonstrated that it does not take a great deal of time to remove the sludge if the tank has not been in operation longer than the period named.

The need for additional sludge digestion space has been urgent for the past few years. In 1916, when the last digestion tanks were built, the sewage flow averaged 39.16 m.g.d. By 1920 this flow had increased to 52.12 m.g.d., with an increase in the quantity of sludge. Fortunately there were several low-lying areas of land in the 468-acre tract reserved for disposal purposes which have been filled with sludge to an advantage. Because of the lack of sludge room part digested sludge has frequently been run on the drying beds, and a longer period of time has been required to dry it.

There are now 19 sludge digestion tanks, of which three are rectangular and 16 are circular. Although all of them adequately serve the purpose for which they were designed, local experience of the past ten years has demonstrated various possible improvements and these have been incorporated into the new tank. The rectangular tanks are a considerable distance from the sludge drying beds. To get the sludge to these beds, a 12-in. open impeller centrifugal pump is used to force the sludge through several hundred feet of 12-in. cast-iron pipe. In performing this operation much water has to be added to get the sludge in a sufficiently fluid condition. Hereafter all of the digestion tanks that are built will be adjacent to the sludge beds so that no pumping will be needed to transfer the sludge to the drying beds.

The old rectangular tanks were built with a covered channel around the top. It was thought that the clarified sewage could be easily removed through this channel but it was found that it distributes itself haphazardly in pockets throughout the sludge accordingly, a similar channel was not incorporated in the tank under construction.

The sludge draw-off points in the old tanks were placed at the bottom since it was supposed that the undigested sludge would form at the top, and in gradually

digesting would settle to the bottom. The reverse condition, however, has usually resulted. To get the well digested sludge at the top, which forms a thick scum, to the sludge beds, a good deal of water has to be added. The circular tanks were also built with draw-off points at the bottom of the tanks, but in these tanks also the digested sludge forms on the top.

TABLE II. COMPARATIVE CAPITAL AND OPERATING COSTS OF PRIMARY SEDIMENTATION AND IMHOFF TANK TREATMENT AT BALTIMORE

	Three Primary Sedimentation Tanks and Nineteen Sludge Digestion Tanks	Twenty-eight Imhoff Tanks
Construction cost	$202,213	$78,400
Fixed charges (interest and depreciation)	$14,155	$5,488
Average yearly capacity, m.g.	16,060	3,650
Fixed charges per m.g.	$0.88	$1.50
Total operating cost (1920)	$67,184	$6,877
Total sewage flow 1920), m.g.	18078.42	986.81
Operating cost per m. g.	$3.71	$6.97

Features of the New Sludge Tank

The new tank has a capacity of 232,500 cu.ft.; is 150 ft. long, 86 ft. wide and from 16 ft. 3 in. to 21 ft. 3 in. deep. The undigested sludge enters the tank near the bottom at both ends. The floor slopes towards the center with a grade of 11.6 per cent so that the tank can be emptied with ease if necessary. There are six manholes along the walls, each with one outlet pipe and three 10-in. circular sluice gates, placed at different elevations. The outlet pipes connect with an existing rectangular concrete channel, 1½ ft. deep and 1 ft. wide, through which the sludge flows by gravity to the drying beds. These channels are built level throughout, and, as they are almost 900 ft. long, it is practically impossible to get sludge to run from one end to the other without overflowing. To prevent this condition, these channels will be made higher.

Sludge is removed from the tank by opening one of the sluice gates, and if undigested sludge runs out another gate at a different elevation will then be opened in order to draw off digested sludge. With 18 sludge outlets situated at different elevations and at different points the chances of being able to remove digested sludge is greatly enhanced. Experiments will be conducted to see what effect, if any, the depth of the tank has on the rate of digestion. The tank was made of such a depth partly to conform to the contour of the ground and partly to give an economical design. The contractor on both tanks was Robertson Bros., whose bid price on the sedimentation tank was $107,055 and on the sludge digestion tank $57,329.

Auxiliary Pumping Station

Another improvement has been the building of a small pumping station. Before this station was built, all of the water from the sludge passed through the underdrains of the sludge beds to a pipe line and emptied into a large pond or stream. As the water from the sludge contained much organic matter in solution, this pumping station was built to intercept it so that there would be no complaint because of odors and the contamination of the pond.

The station is provided with two 5-hp. vertical a.c. motors, direct-connected to two 2-in. centrifugal closed impeller sump pumps, each having a capacity of 160 gal. a minute against a static head of 43.5 ft. The pumps are in separate wells so that if one breaks down it can be repaired while the other is in operation. There is an overflow from the station, which will be used only if both pumps are out of service. The water is pumped through a 4-in. cast-iron main to the effluent channel of the primary sedimentation tanks, from which it flows through the trickling filters and the final settling basins. Each pumping unit will work automatically.

Ordinarily the sluice gate connecting the two wells at the bottom will be left open so that a greater storage space will be available. The floats on the pumps will be set at different elevations so that if one fails to start the other pump will be in reserve when the level of the water reaches the elevation of the higher float. This station was built by the Whiting-Turner Construction Co.

The improvements as a whole are under the supervision of A. E. Christhilf, highways engineer, with Milton J. Ruark at the head of the sewer division. The author is in charge of the design and construction of this work, and J. S. Gorsuch has direction of the field operations.

Conference Accepts Reports Outlining Unemployment Relief

Permanent Measures Included—State Employment Offices Urged—Financing, Material and Labor Costs Deter Construction

DURING the three sessions which came to a close Oct. 13 with its adjournment *sine die*, the President's Unemployment Conference received reports from various committees and adopted recommendations which outline in general and in detail recommendations for both emergency and permanent relief of unemployment. Outstanding were the report of the committee on construction industries, the report of the committee on employment agencies, and the general recommendations arrived at by the conference itself and presented during its last session.

Temporary Relief Measures

Construction Financing—The committee on construction industries felt that a return of confidence in values in construction would assure more employment than in any other business, inasmuch as more than 2,000,000 people could be employed if construction should be appreciably resumed. Its report indicated that the three great factors affecting a resumption of construction activity were financing, material costs and labor costs, and that throughout the country owners had declined to start new projects because of financing charges, commissions and premiums at times reaching from 10 to 20 per cent being charged in addition to from 7 to 8 per cent interest on money loaned. Excessive financing charges for building had been exceptional, and the committee found many savings banks, trust companies, and insurance companies had maintained a conservative loaning policy with regard to real estate and home building, and that the building and loan associations with their $2,500,000,000 in assets had been conducted with exceptional efficiency. The committee reported that, underlying the whole matter of the financing of construction, there is, however, "the sound banking principle that long-term deposits and the savings accounts of the people should primarily be

used for long-term purposes and should not be intermingled with business carried on for speculative and business purposes."

Materials and Labor

Construction Materials—Though there have been substantial reductions in some construction materials, the committee found that other construction materials had not yet been reduced in keeping with the trend of wholesale prices of other commodities, and that in some instances retailers of construction materials had failed to follow reductions of manufacturers and wholesalers.

Labor—As to labor costs, the committee reported that wages should be such as to allow not only proper education of the family of the laborer, but systematic, though small, saving. In reporting upon unfair practices the committee asserted that "all practices which unnecessarily retard the work or add to its cost should be immediately discountenanced and abandoned if the confidence of the public is to be fully restored."

Other Considerations—In order further to revive activity in the construction industry the committee recommended readjustment of freight rates on a more equitable basis, the ironing out of inequalities in the freight schedules, the elimination of priorities, and the standardization of building codes.

In its recommendation to the general conference the committee on construction industries recommended the appointment of a committee selected from various elements interested in construction which would be charged with the responsibility of co-operating with the governors and mayors in the several states in carrying on community conferences on construction and to look to the removal of unnecessary or inequitable limitations and restrictions which have retarded real construction activity.

Employment Agencies—The committee on employment agencies recommended the extension of state employment agencies, asserting that the state and not the federal government should operate the local offices and do placement work. However, it was recommended that the federal government could assist the state employment agencies in the collection, compilation, and distribution of statistical information and general information which would facilitate interstate placement, and do educational and other work which would improve employment standards. With this view of federal co-operation with the states in mind, the committee on employment agencies and registration urged that Congress be asked to appropriate $400,000 to enable the United States Employment Service to operate more actively in the interstate field.

Permanent Unemployment Relief

The general recommendations which the conference adopted for permanent recovery from unemployment included: (1) Readjustment of railway rates to a fair basis of relative value of commodities; (2) speedy completion of the tax bill; (3) a definite settlement of tariff legislation; (4) a settlement of the financial relationship between the government and the railways; (5) limitation of world armaments; (6) steps looking to the minimizing of fluctuations in exchange; (7) definite programs of action that will lead to elimination of waste and more regular employment in seasonal and intermittent industries; and (8) the elimination of the disproportion between the primary price of commodities and the ultimate retail price, the disproportion being due to increased cost of transportation, large profits, interest, taxes, labor, etc. The conference concluded that since the buying power of the different elements of the community was to be restored, these levels must reach nearer a relative plane.

"For example," cites the conference report, "the farmer cannot resume his full consuming power and thus give increased employment to the other industries until either his price is increased or until more of the other products and services come into fair balance with his commodities and therefore the reach of his income." As an indication of this disproportion, the approximate index numbers of various commodities were included in the conference report. The index numbers are based upon 100 for 1913 and are cited as of August, 1921. They are as follows: Cost of living, Department of Labor (May survey), 180, National Industrial Conference Board, 165; average price to producer, farm crops, 109; average price to producer, live stock, 113; average wholesale price, foods, 152; average retail price, foods, 155; wages in meat packing, 186; freight rates, dressed beef, Chicago to New York, 214.

The disproportion existing in index numbers in the building industry were indicated as follows: Lumber, average Southern pine and douglas fir at the mill, 128; brick, average common, New York and Chicago, 199; cement, portland, net without bags to trade f.o.b. Buffington, Ind., 175; freight rate on common brick from Brazil, Ind., to Cleveland, 204; freight rate on cement from Universal, Pa., to New York, 179.

The conference found that the index number for the union scale of the average of fifteen occupations in building labor was 190. The union scale with a weighted average of eight occupations on frame house construction was 177, and the union scale with a weighted average of eight occupations in brick house construction 193. The index number of common labor was found to be 130.

Clean Concrete Paving Joints With Automobile Exhaust

An inexpensive method for cleaning joints and cracks in concrete pavement before filling with tar has been devised by Burgess & Dorrier, contractors, of Scottsville, Va.

The method involves the use of a 30-ft. length of ¾-in. rubber hose, provided with a ½-in. gas pipe nozzle. The hose is attached to the exhaust pipe of the small motor truck used for hauling the tar kettle and other tools. The end of the gas pipe nozzle is drawn down to ¼-in. diameter. The crack or joint to be cleaned is first freed from any tightly packed dirt by means of a metal cleanout hook. The material thus loosened is then dislodged by directing the exhaust pressure of the motor, by means of the hose and nozzle into the joint. The motor is speeded up to produce the necessary pressure at the nozzle. This method leaves a clean crevice. The exhaust gases, being warm, evaporate any moisture that may be present in the edges of the concrete, thus insuring a good bond between the concrete and the hot bituminous filler. The method is stated to be much quicker and more effective than the commonly used street broom, especially in getting rid of the fine dust which, if left in the crevices, may prevent the bitumen from adhering to the concrete.—*The Concrete Highway Magazine.*

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

How the Patent Office Could Help Thousands

Thousands of users of the printed copies of patent specifications issued by the United States Patent Office must curse the government daily for persisting in leaving the first page of these valuable documents entirely blank. If instead of this the patent number, date, title, and the name of the patentee were printed on the first page a vast amount of time and profanity would be saved to thousands. Or, if the government balked at the extra cost thus involved, it might omit the blank cover page and place the drawings at the end instead of the beginning of the document, thus revealing the basic information which every user of each patent wants every time he has occasion to refer to a patent. As the matter now stands, every one who has occasion to file a patent for reference is compelled to write more or less of the information suggested above upon the blank page for purposes of identification. Why a vast number of people should be compelled to do each for himself what could readily be done by the government's printing presses is a mystery.

The Design of Centrifugal Pumps

—REVIEWED BY ROBERT E. HORTON, Consulting Hydraulic Engineer, Voorheesville, N. Y.

CENTRIFUGAL PUMPS—By J. W. Cameron, A.M.I. Mech. E. London: Scott, Greenwood & Son. New York: D. Van Nostrand Company. Cloth; 6x9 in.; pp. 142, illustrated. $3.75.

The author of this book evidently presents a digest of notes and formulas used by him in practical centrifugal pump design. The introductory chapter discusses in non-mathematical language the modus operandi and advantages of the categorical type of turbine pump. Unfortunately, the book begins with a definition of the centrifugal pump that applies equally well to reciprocating and other pumps. A second definition of the centrifugal pump is given as "a reversed radial inward flow reaction turbine." While interesting and descriptive, this definition is wanting in other respects.

The hydraulic theory of centrifugal pumps as related to practical design is treated concisely, yet clearly, in a space of ten pages. Some very good diagrams used in this section to illustrate the vector relations of flow through centrifugal pumps could be greatly improved in clarity. Next follows a chapter on hydraulic losses during the passage of fluid through the pump. Formulas and, where available, experimental data for calculation of these losses, are given. The mode of occurrence of losses is rendered clear by illustrations. M. Hanocq's formulas for friction losses in guide and runner passages are given and will be new to many English readers.

The following chapter covers calculations of the hydraulic efficiency obtainable with turbine pumps of various designs. The theory and design of shaft bearings and the determination of bearing and disc friction are next taken up, thus laying a complete foundation for the succeeding chapter which covers calculation of over-all efficiency, including both mechanical and hydraulic losses. A chapter on the effect of the angle of discharge on efficiency completes the portion of the book devoted to general theory. It is followed by details of mechanical design of the various parts of turbine pumps, including casings, impellers, shafts and axial thrust bearings. Then actual designs of single- and multi-stage pumps are worked out in detail.

The 97 pages of the book thus far covered are remarkable for clearness and compactness. Apparently there is little omitted that is essential. The next chapter (30 pp.) gives brief descriptions, with many half-tone illustrations (some are poor), of typical designs and installations of one English, one Swiss and one American pump builder. Descriptions are meager and superficial. Hydraulic characteristics and efficiencies are not given, and this chapter adds little value to the book.

Probably all that is given in this book is available elsewhere, but there appears to be no book that gives the essentials of ordinary turbine pump design in an equally complete and compact form with so little abstruse theory.

For the Practical Concrete Man

CONCRETE WORK: Vol. II. A book to Aid the Self-Development of Workers in Concrete and for Students in Engineering—By William Kendrick Hatt, C.E., Ph.D., M. Am. Soc. C. E., M. Am. Soc. T. M., M. Soc. Prom. Eng. Ed.; Professor of Civil Engineering, Director of Laboratory for Testing Materials, Purdue University, Lafayette, Ind.; President, American Concrete Institute; and Walter C. Voss, B.S., Assoc. M. Am. Soc. C. E.; M. Am. Soc. T. M.; M. Am. Conc. Inst., Head, Department of Architectural Construction, Wentworth Institute, Boston, Mass.; Licensed Architect, State of Illinois; Master Builder Boston. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd Cloth; 5 x 8 in.; pp. 206. Illustrated. $2 postpaid.

Vol. I of this novel treatment of concreting was reviewed in *Engineering-News-Record*, March 17, 1921, p. 475. The second volume is, according to the preface, prepared to develop the practical ability of the concrete worker, the inspector and the student in technical schools, which is effected by successive job sheets, beginning with the use of the triangle and continuing through methods of building a pile wall, determining where tension and compression occur in beams, of ascertaining proper location of reinforcing rods, and similar elements of the concrete art. No better book for the practical concrete man has been written, but it requires considerable study and experience on the part of the instructor to make it most effective for the student.

Valuable Work on Forestry in France

STUDIES IN FRENCH FORESTRY—By Theodore S. Woolsey, Jr., Consulting Forester, Author of French Forests and Forestry (Tunisia, Algeria Corsica), and Executive Member Interallied War Timber Committee, Paris, 1917-19; with Two Chapters by William B. Greeley, Forester, U. S. Forest Service, and formerly Chief, Forestry Section C. and F., S. O. S., American Expeditionary Forces. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 550; illustrated. $6.

France has done so much in forestry and done it so well that a careful study of her forestry policy, methods, and results, such as is presented in this volume, cannot fail to be of interest and value to all interested in forestry, whatever their country. The book contains much that has a direct appeal to Americans. The chapter of widest general interest here is Colonel Greeley's

spirited account of "The American Forest Engineers in France." Chapters of direct appeal to engineers are those dealing with engineering works and with planting to prevent erosion in the mountains and to control and utilize vast sand dunes. A number of appendixes add largely to the mass of data and opinion which the volume affords.

Insects and Communicable Diseases

SANITARY ENTOMOLOGY: The Entomology of Disease, Hygiene and Sanitation—Edited by William Dwight Pierce, Ph.D., Consulting Entomologist, formerly Entomologist South Field Crop Insect Investigations, United States Department of Agriculture, Bureau of Entomology. Boston: Richard G. Badger. Cloth; 6 x 10 in., pp. 518; illustrated. $10 net.

Not the least valuable feature of this comprehensive survey of insect life in its relation to disease among man and some of the domestic animals is its promise of stimulating still further research into the mysteries of some of our most dreaded communicable diseases. The volume originated as a series of lectures by ten entomologists delivered during the war—and also circulated in mimeographed form at that time. Most of the lectures were subsequently revised for publication.

After a number of general lectures or chapters on how insects carry disease, the "needs of entomological sanitation" in America, and the "seriousness of insect-borne diseases to armies," the several authors take up the relation of insects to the parasitic worms of vertebrates, the bearing of climate and life on medical entomology, non-biting and biting flies, mosquitoes, lice, fleas, cockroaches, bedbugs, mites and ticks, flies and lice in Egypt, insects in relation to packing houses, and poisoning by insects. Some 26 pages are filled with a tabulation of data on the transmission of specific diseases by insects.

The general plan followed is to present for each main class of insect the diseases which it bears, with much related data; the biology of the insect, and means for its control. Such topics as the disposal of garbage, human and animal excreta are considered, and also drainage in its relation to mosquito breeding. The larger part of the space is given to the insects and dangerous organisms that they harbor and spread. A vast amount of material was gone over, in the preparation of the volume, digested, classified and interpreted. Chapter-end bibliographies give abundant references to more detailed sources. The volume promises to be of great usefulness.

A British Who's Who in Engineering

WHO'S WHO IN ENGINEERING—Edited by John Ed. Sears, C. B. E., M. A., Assoc. M. Inst. C. E. 1920-21. London: The Compendium Publishing Co. Cloth; 7 x 10 in.; pp. 426.

Besides following the well-known lines of the general personal reference manuals in giving biographical information regarding the leading engineers, in this case with particular attention, of course, to their engineering education and experience, this volume contains a section devoted to "The Engineering and Allied Trades," classified indexes for both the engineers and the concerns engaged in the production of materials and appliances of engineering, and several unique additional sections. The latter are devoted to the various engineering societies, the technical schools, the trading and research associations, the associations of employers and also of employees, and the engineering journals of Great Britain. In the section devoted to engineers there is a separate paragraph, where called for, giving the "war service" of each engineer.

Graphical Representation

GRAPHIC PRODUCTION CONTROL—B. C. E. Knoeppel, Member Society of Industrial Engineers, M. A. S. M. E.; Assisted by Various Members of the Author's Firm and Staff. New York: The Engineering Magazine Co. Cloth; 6 x 9 in.; pp. 477; illustrated. $10.

Graphic representation has been extended in recent years to give a line picture instead of a word picture of trends, developments, and in fact a record of any business operation which has continuity. The physician charts temperature curves, the production manager graphs output with the proper cost distribution, the busy executive watches the general conduct of his business through series of charts. But not everyone can produce a graph that tells the exact manner in which a business is being conducted and a chart that will denote "graphically" what the status of industry is. To give this information is the aim of this book. The author plans in detail the application of graphs to production in its thousand and one uses. The volume explains at length the history of graphical representation, and gives instances of its more popular as well as technical application.

Weekly Foreign Commerce Reports

Beginning Sept. 5, "Commerce Reports," published by the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, became a weekly ($3 a year for domestic and $5 a year for foreign circulation, from Superintendent of Documents, Washington, D. C.) instead of a daily. In the new form the material is classified by commodities and edited by specialists. Among the eleven divisions thus far established are iron and steel, industrial machinery, electrical equipment and supplies, lumber, automotive equipment, and agricultural implements and vehicles. To save delay in making important information available, Secretary Hoover states in his foreword to the first issue of the new weekly, "special material will be released to the press immediately upon its arrival, in advance of the weekly publication."

The Industrial Digest

A semi-monthly digest of selected material from 600 Journals covering 30 "industries" started its first number on Oct. 1 (The Periodical Digest Corporation, 25 W. 45th St., New York City; $5 a year in U. S.; $6 in Canada; $7 elsewhere). Among the "industries" covered are Building and Construction; Cement, Stone and Brick; Electrical; Iron and Steel; Economic; Financial.

Research Narratives

For the purpose of stimulating "interest in increasing the resources of Engineering Foundation" (Engineering Societies' Building, New York City) that body has begun the publication of a bimonthly series of "Research Narratives" that it expects to continue for a short time. The first one is entitled "Isolated Research: Its Handicap—The Story of Mendelism."

Industrial India

A monthly journal entitled "Industrial India," devoted to the development of India's resources, is now being issued by the Tata Publicity Corporation, Bombay and Calcutta, with a London office at Kern House, 36 Kingsway, W. C. 2.

PUBLICATIONS RECEIVED

THE AMERICAN RAILROAD PROBLEM: A Study in War and Reconstruction—By I. Leo Scharfman, Professor of Economics, University of Michigan. New York: The Century Co. Cloth; 5x8 in.; pp. 474; $3.

AMERICAN SOCIETY FOR TESTING MATERIALS STANDARDS: Triennial Issue, 1921—Philadelphia, Pa.: American Society for Testing Materials. Cloth; 6x9 in.; pp. 890; Folding Plates and Figures in the Text. $10. Half leather, $11.50.
These engineering standards, "consisting of Standard Specifications, Standard Methods, Standard Definitions, Recommended Practice," now total 160, divided as follows: Steel and wrought iron, 61; pig and cast iron and finished castings, 7; non-ferrous metals, 31; cement, lime, gypsum and clay products, 18; preservative coatings and lubricants, 10; road materials, 19; coal and coke, 4; timber, and timber preservatives, 6; rubber, 2; miscellaneous subjects, 2. All the standards adopted up to June, 1921, with subsequent revisions, are given. The volume is worthy of a place in every engineering office in the country.

ANALYTICAL MECHANICS FOR ENGINEERS—By Fred B. Seely, M.S., Associate Professor of Theoretical and Applied Mechanics, and Newton E. Ensign, A.B., B.S., Associate in Theoretical and Applied Mechanics, University of Illinois. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 436; illustrated. $4 postpaid; 24 s. net.

ANNUAL CONFERENCE ON CITY PLANNING: Proceedings at Pittsburgh, May 9 to 11, 1921—Flavell Shurtleff, Secretary, 60 State St., Boston, Mass. Cloth; 6x9 in.; pp. 206.
Contains papers on the city plan, zoning, aerial photography, etc.

BRÜCKEN IN EISENBETON—Ein leitfaden fur Schule und Praxis von C. Kersten, vorm. Oberingenieur, Oberlehrer an Der Baugewerkschule, Berlin. Teil I. Platten- und Balkenbrücken mit 605 Textabbildungen, Fünfte Neubearbeitete Auflage. Berlin; Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 256. Paper, 36m. Cloth, 42m.
The first edition of this work was reviewed in *Engineering News*, May 16, 1907.

CANADIAN RAILWAY STATISTICS, 1919—Ottawa Dominion Bureau of Statistics, Transportation Branch. Paper; 6x9 in.; pp. 272. 20 cents.

COLUMNS: A Treatise on the Strength and Design of Compression Members—By E. H. Salmon, D.Sc. (Engineering) London, Assoc. M. Inst. C. E. From a Thesis Approved for the Degree of Doctor of Science (Engineering), in the University of London. London: Henry Frowde and Hodder & Stoughton. Cloth: 6x9 in.; pp. 279; illustrated. 31/6 net; postage 1s. extra.

COURT DECISIONS ON WORKMEN'S COMPENSATION LAW, JANUARY, 1920, TO JUNE, 1921—Albany, N. Y.: Department of Labor. Paper; 6x9 in.; pp. 302.

DIE NATURWISSENSCHAFTEN IN IHRER ENTWICKLUNG UND IN IHREM ZUSAMMENHANGE: Dargestellt von Friedrich Dannemann, Zweite Auflage II Band: Von Galilei Bis Zur Mitte Des XVIII. Jahrhunderts, Mit 132 Abbildungen Im Text und Mit Einem Bildnis Von Galilei. Leipzig: Wilhelm Engelmann. Paper; 6x9 in.; pp. 508. 75 marks; bound, 85 marks.

ELEMENTS OF SPECIFICATION WRITING—By R. S. Kirby, C. E., Assistant Professor in the Sheffield Scientific School of Yale University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 153. $1.50 net (9/-net).
This edition has been revised to accommodate the text to certain developments in contracting since the war, principally the cost-plus contract in its various stages. It is frankly a student's book and an excellent one of that class. It is well arranged, clearly sub-headed, and definite in its statements.

FOOD INVESTIGATION BOARD: Report for 1920—(British Department of Scientific and Industrial Research). London: His Majesty's Stationery Office. Paper; 6x9 in.; pp. 39. 1s. net.
Contains summaries of technical investigations by various committees, including one on engineerings, concerned chiefly with cold-storage problems. Bacterial studies are also reviewed.

FOURTEENTH CENSUS OF THE UNITED STATES, Vol. I, Population, 1920: Number and Distribution of Inhabitants—By William C. Hunt, Chief Statistician for Population. Washington, D. C.: Bureau of Census. Paper; 9x12 in.; pp. 695; a few maps.
A brief introductory summary is followed by population for 1920, 1910 and 1900 by states, counties, incorporated places, and other minor civil divisions.

HANDBOOK OF THE BUILDING TRADES EMPLOYERS' ASSOCIATION OF THE CITY OF NEW YORK, 1921—A list of Members, the Rates of Wages, the Joint Arbitration Plan, Provisions of Trade Agreements Setting Forth the Work Claimed by Each Union; Decisions Governing in Questions of Jurisdiction of Trade. New York: The Association, 30 W. 33rd St. Paper; 6x9 in.; pp. 176.

INDIAN RAILWAY BRIDGE COMMITTEE—Vol. I, Fourth Report. Technical Paper No. 224; Containing a Report by H. S. Sales, Investigating Officer, on Impact Tests of December, 1919-March, 1920. Calcutta: Superintendent of Government Printing. Paper; 8x13 in.; plates and diagrams. 5Rs.

KANSAS HIGHWAY COMMISSION: Report for 1919 and 1920—Topeka, Kan.: The Commission. Paper; 6x9 in.; pp. 270.

LAWS AND RULES RELATING TO PUBLIC WATER SUPPLIES AND THE ERECTION OF DAMS—Trenton, N. J.: The Department of Conservation and Development. Paper; 4x6 in.; pp. 52.
Contains basic laws giving control of certain phases of water supply to State Water Supply Commission and later on transferring same to district commissions and some to the department named. Includes rules for applications for water-supply rights and for filing plans of dams. Control of the purity of water is exercised by the State Department of Health and over rates and service by the Public Utilities Commission.

A MAJOR STREET PLAN FOR PITTSBURG; Report No. 2, Sept. 1921. Pittsburgh, Pa.: Citizens' Committee on City Plan of Pittsburgh. Paper; 8 x 11 in.; pp. 65. 50c.

MECHANICS—A Text-Book for Engineers, First Edition—By James E. Boyd, M.S., Professor of Mechanics, The Ohio State University; Author of "Strength of Materials," "Differential Equations for Engineering Students," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 417. $3.50.

MANUAL ON ROAD CONSTRUCTION FOR RESIDENT ENGINEERS AND INSPECTORS—By B. H. Piepmeier, Engineer of Construction, Division of Highways. Springfield, Ill.: Department of Public Works and Buildings. Paper; 6x9 in.; pp. 73; illustrated.
Contains much information on organization, inspection and details of various current types of road construction.

MODERN BUILDING SUPERINTENDENCE AND THE WRITING OF SPECIFICATIONS—By David B. Emerson. New York: Charles Scribner's Sons. Cloth; 5x7 in.; pp. 247. $1.75.
A readable but unillustrated description of the materials and some of the construction features of a 20-story modern office building, with general remarks on specifications and a section on specifications for a small house. Originally written for juniors and students and published serially in an unnamed "magazine." A creditable production within its actual limits, but while more up-to-date, so far as it goes, than T. M. Clark's "Building Superintendence" (see *Engineering News*, June 18, 1903, for notice of revised edition) it falls far short of covering the same ground as does that much larger, more comprehensive and liberally illustrated book. A concluding chapter contains some valuable hints on a reading course for draftsmen—but wholly in the field of building as a fine rather than an industrial art.

NATIONAL DRAINAGE CONGRESS: Proceedings, 1920—Chicago, Ill.: L. K. Sherman, Director. Paper; 6x9 in.; pp. 57.
Papers on land drainage, river regulation and malaria control, presented at the convention at Atlanta, Ga.

NEW YORK PUBLIC SERVICE COMMISSION, SECOND DISTRICT: Report for 1920, Vol. I—Albany: The Commission. Cloth; 6x9 in.; pp. 202.

OBRAS PUBLICAS VENEZUELA: Memoria que presenta el Ministro de Obras Publicas a las Camaras Legislativas en su reunion constitucional de 1921. Caracas: Minister of Public Works. Paper; 9x12 in.; pp. 516; halftones, line drawings in text and on folding plates.
A handsomely illustrated annual report on the various public works activties of the department.

OIL-CAMP SANITATION—By C. P. Bowie. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 32; illustrated. 10c. from Superintendent of Documents.

OKLAHOMA SOCIETY OF ENGINEERS TRANSACTIONS, 1921—Tulsa: Donald Witten, Secretary-Treasurer. Paper; 9x12 in.; pp. 51.

ONTARIO HYDRO-ELECTRIC POWER COMMISSION: Report for 1919-20, Vol. I—Toronto: The Commission. Paper; 7x10 in.; pp. 326; illustrated.

PETROLEUM LAWS OF ALL AMERICA—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 645. 40c. from Superintendent of Documents.
Covers both continents, nationally and by states and provinces

PLATTING REGULATIONS—The Approval of Plats and Other Requirements. Detroit, Mich.; City Plan Commission. Paper; 7 x 10 in.; pp. 8.

RADIO-COMPASS BEARINGS—By Oscar S. Adams, Mathematician, U. S. Coast and Geodetic Survey—Washington, D. C.: Free on application to Director. Paper; 6x9 in.; pp. 39. 5c. from Superintendent of Documents.
Gives simple instructions for two different methods of plotting a ship's position at sea by means of radio-compass bearings and a mathematical development and discussion of the two methods.

THE RAILROADS OF MEXICO—By Fred Wilbur Powell, Ph.D. Boston: The Stratford Co. Cloth; 5x7 in.; pp. 220. $2, plus postage.
Deals mainly with the history and development of the railway system and some of its more important lines. A useful feature is a 24-page bibliography. The one map is of little use, the lettering being almost illegible.

RAILWAY SYSTEM LIGHTING FOR BUILDING AND YARDS—Compiled by J. H. Kurlander, Lighting Service Department, Edison Lamp Works of General Electric Co. Harrison, N. J.: The Company. Paper; 6x9 in.; pp. 32; illustrated.

REGULATIONS FOR THE INSTALLATION OF ROTARY AND CENTRIFUGAL PUMPS and for Electrical Driving and Gasoline Engine Driving of Fire Pumps, 1921—Boston, Mass.: National Fire Protection Association. Paper; 3x5 in.; pp. 100.

THE ROCKEFELLER FOUNDATION: A Review for 1920. The Program for 1921 By George E. Vincent, President. New York: The Foundation. Paper 6x9 in.; pp. 47; illustrated.

STATISTICS OF RAILWAYS IN THE UNITED STATES: Report for 1919—Washington, D. C.: Bureau of Statistics. Paper; 9x11 in.; pp. 83. 15c. from Superintendent of Documents.

STEAM VERSUS ELECTRIC LOCOMOTIVES FOR HEAVY GRADES—By T. A. F. Stone, B.E., A.M.I.M.E.; Locomotive Department, Indian State Railways. Technical Paper No. 220, Railway Board, Simla, India. Calcutta, India: Superintendent Government Printing. Paper; 8x13 in.; pp. 39; with diagrams. 1 Real 12 Annas.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Road Loads Must Be Limited

Sir—In your issue of Sept. 29, p. 511, you quote from the testimony I gave the Senate Committee on Interstate Commerce. I am afraid that part of my testimony has been overlooked and an entirely incorrect view presented to the engineering profession. You also refer to my remarks as the railroad viewpoint. This may be so of some railroad officials but if it is I have not come in contact with them. I am a consulting engineer in private practice with highways as a specialty and I believe that my viewpoint is rather that of those interested in economical transportation than of the railroad industry. As a matter of fact I know of no body of men that taken as a whole are so interested in providing good roads to the country as the railroad managers whom I have met.

The part of my testimony given to the Senate Committee on Interstate Commerce, which you have overlooked, reads as follows:

"I of course do not mean to suggest that highways between large centers be not maintained to a high degree of excellence but I do affirm that it is unnecessary to construct these highways so that gasoline locomotives can be operated over them and that the major portion of the road funds available be consumed in their construction and maintenance to the detriment of tributary territory."

The highway system of this country is being rapidly wrecked by loads moving over it that are far in excess of even the ultimate strength of the roads when considered as a structure. Every state has many miles of road that are today almost impassable as a result of a few heavy trucks operating over them. So-called outlaw truck companies have developed. They operate in a district that has good roads until their heavy equipment ruins the roads and then they move on to another district and repeat the performance.

California had one of the most complete system of good roads that had ever been built. The automobile associations of the state, realizing that this road system was deteriorating after a very short life, employed the leading engineers on the Pacific coast to find the cause. Below I give extracts from their report that show the condition of these roads and the cause of their failure.

"We find ourselves at the end of four short years with but fifty per cent of our state roads, especially in southern California, pronounced good with the remainder classified as fair and poor. In southern California field inspections indicate that as high as 30.5 per cent of the concrete pavements are in poor condition, requiring reconstruction either now or at an early date. An additional 19.3 per cent is in only fair condition, serious failure having already begun."

In pointing out one of the main causes the California engineers say: "It seems incredible that in the face of such a record of destruction of the state pavements that these persistent, unreasonable and illegal loads should be continuously permitted to traverse our highways."

The record of failure of highways is the same the country over. In Texas we find the Brownsville "Sentinel" complaining of the failure of Cameron county's most expensive highway, a concrete pavement 7 in. thick and heavily reinforced with steel.

The editorial reads as follows: "The road has cost almost $49,000 per mile to build. It is less than two months old and with a surface that is wearing so badly and cracking so rapidly that you cannot blame those interested from being anxious to disclaim responsibility."

In Maryland we find Chief Engineer Mackall of the Maryland State Roads Commission describing the failure of the Washington road as follows: "Failure of the concrete sections on the Washington road was due to the most part not to poor subgrade nor to insufficient depth of concrete, but to disintegration of the surface."

If what remains of the country's highway system is to be saved from destruction some measures must be immediately taken to establish what is the safe load of different sections, material, and design to carry with the proper factor of safety, and then vehicles weighing in excess of these limits must be prevented from entering districts, the roads of which are incapable of carrying them.

Engineering News-Record is the paper that could best voice a demand that the highway program of this country, both as to design, construction, and operation be placed on a scientific basis.

I should be greatly interested in knowing if after you have read the complete text of my testimony given to the Senate Committee you do not more or less agree with me and if not would it be presumption to ask you to point out in your paper definite rasons why you do so.

Chicago, Ill., Oct. 10. STUART B. MOORE

[We regret having miscontrued Mr. Moore's point of view—due to the fact that only part of his testimony was at hand. That misconstruction, however, does not invalidate the main contention of the editorial in question, that the railroad point of view is of value in helping to secure an adequate consideration of motor vehicle fees.

It is hardly necessary to remark that we are in full agreement with him as to limitation of loads. That view has been expressed editorially at frequent intervals. Opinions differ, of course, as to what should be the proper limits, but the researches under way at Washington, the studies on the Illinois and California test roads, and similar inquiries elsewhere should yield much data on which limiting loads can, with some degree of scientific sanction, be based. —EDITOR.]

Oiled Cinder Streets for Light Traffic

Sir—I have read with interest the article on roads treated with cinders in the Sept. 22 issue, p. 477, and your comment on p. 510 of the issue of Sept. 29.

Cinders have been used on streets for light travel in Appleton, Wis., for a number of years. We have a population of 20,000; there are paper mills and other industries producing a large volume of cinders which the city gets for the hauling, as the mills are glad to get rid of them. Our sub-soil is a heavy, red clay which, in wet weather, is almost impassable. The streets generally 24 ft. wide, are improved in the following manner:

We excavate the surplus earth 12 in. below the grade and then fill in the cinders. After a block has been filled a 10-ton roller is used to compact them; then a light grader smoothes up the surface prior to a second and final rolling. Best results are obtained when a little water is used and on streets having curbs. In no case, however, has the clay sub-soil ever worked through the cinder layer.

After the first year some of these cindered streets were oiled with a 65 per cent asphaltic oil and the results are excellent. After several applications of oil a mat forms which prevents dust and holds the shape of the road.

This construction, of course, is only for light-traveled residential streets and the cost is very low. On a 24-ft. roadway, we charge the property owners 25c. per foot for the complete work of excavating and placing the cinders. If the street is later oiled, the charge is about 6c. per front foot each season; this figure includes the material and labor. The oil is covered with a light coat of screenings or coarse sand—just enough to keep it from being picked up by vehicles.

Cindered streets will last for years, depending on the travel, and are very easily maintained. No doubt there are many cities that have cinders available, but have not used them. Perhaps these suggestions will help them with some of their problems. OSCAR F. WEISGERBER,

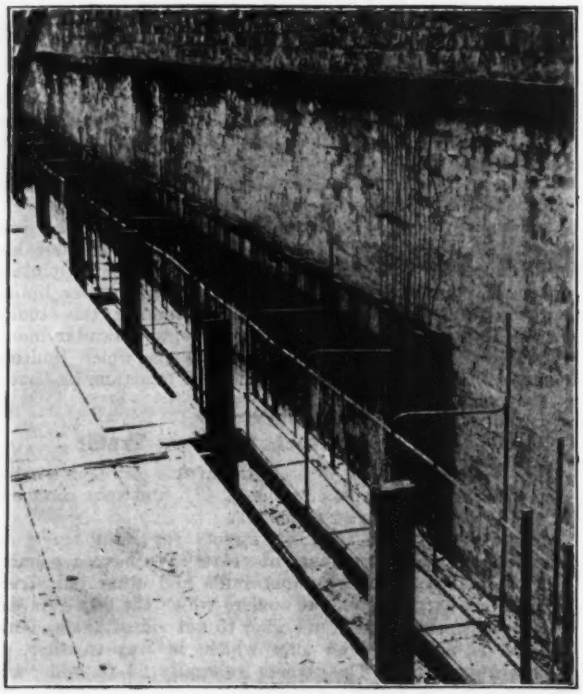
City Engineer and Street Commissioner.

Appleton, Wis., Oct. 3.

HINTS FOR THE CONTRACTOR

Concrete Forms Removed from 2-In. Space

IN BUILDING a substation recently completed in San Francisco, it was necessary to construct a concrete wall as close as practicable to the adjoining brick building without leaving any contact with the latter through which vibration might pass from one structure to the other. The concrete wall was located so that its finished surface is only 2 in. from the adjoining building and the forms were arranged so they could all be taken out of this space after the concrete set.



VERTICAL SHEATHING SHOWING WIRES TO BATTENS

In setting the wall forms the first operation was to fasten a horizontal run of 1 x 4-in. battens to the brick wall at a level above the top of the section to be poured. From nails driven into these battens No. 10 wires were strung vertically, and on their lower ends other horizontal 1 x 4-in. battens were suspended. Each suspended batten was held by two wires, one to each end, the arrangement being such that a series of continuous runs of battens were hung 2 ft. apart horizontally for the full length and height of the concrete wall to be constructed. The nails were all numbered, corresponding numbers being used on nails carrying wires to opposite ends of the same run of battens. The batten runs were numbered consecutively from the top down.

The next step was the placing of vertical sheathing of 1 x 6-in. lumber. This sheathing, 20 ft. long, was placed and the wall was poured in two vertical stages of 20 and 10 ft., respectively. As fast as the sheathing was set up it was held in place by the inner half of the concrete form which was built up at the same time. This inner half was of the usual design except that instead of wires to hold the two sides of the form together, ⅝-in. lag bolts, 17½ in. long, were used. These lag bolts were screwed entirely through the sheathing and battens and were turned until they pressed slightly against the brickwork so that the concrete form was held firmly to its prescribed width of 6 in. Thus, braces running down from the form to the interior of the building under construction could hold the form firmly against the brick building while the concrete set.

Vertical sheathing, battens, and the lag screws were thoroughly smeared with crude oil before the forms were erected. After the concrete had set the inside forms were taken down and the bolts removed. The battens were then drawn up by means of the wires, the workmen taking care to pull wires in the proper numerical order. Finally, the vertical sheathing was withdrawn by hand. This entire operation of clearing the 2-in. space went forward rapidly and without hitch, all of the material used in this space being removed from both the 20- and 10-ft. sections. The holes left in the concrete wall by the lag bolts were filled with maple dowels, turned with a taper to insure a tight fit.

The contract for the construction of the substation was carried out by Chadwick & Sykes, engineers and contractors, San Francisco, Cal.

Surfacing Concrete Blocks

WHITE cement for both white and colored finish of concrete building blocks was recommended at the recent annual meeting of the Concrete Products Association, at Chicago, by Gale M. Brooks, engineer of the technical department of the Atlas Portland Cement Co. An abstract of his paper is given below:

A white mortar facing made with white sand or marble dust in which $\frac{1}{16}$-in. particles predominate will make a good surface which is an integral part of the block. This facing need be only ½-in. thick and can be used with little additional labor in manufacture. With a 1:3 mix of white cement and white sand, the body of the block can be made with a leaner mix and larger aggregate than would be used otherwise. Colored sands may be used, or mica spar mixed with the white cement and white sand to give a surface lightly flecked with black. Brownish yellow sands with the white cement give various shades of buff. A little selection of sand will permit the matching exactly of any desired natural stone color.

Further variety of surface can be secured by the use of color aggregates with the white cement motar, such as one part white cement, 1½ parts white sand and 1½ parts of $\frac{1}{16}$- to ¼-in. granite or marble chips. The thin film of cement on the surface when the block comes from the form can be removed with a very fine spray of clear water if the forms are removed early. If the blocks are allowed to harden more thoroughly before being released from the forms, this film can be removed by washing the surface with 1 to 3 diluted muriatic acid or by rubbing with a carborundum block. A power polishing machine may be used where a smooth surface is desired.

In place of the white sand, marble dust can be used in conjunction with the coarse color aggregate, but the dust should have a large percentage of coarse particles, $\frac{1}{32}$- to $\frac{1}{16}$-in. The dust of pink granite mixed with the ¼-in. chips and white cement gives a good surface. Delicate color tints can be secured by the use of mineral pigments with white cement, but too much pigment weakens the stone and increases the chance of fading and of uneven distribution in the mixture.

NEWS OF THE WEEK

New York, October 20, 1921

President's Conference on Unemployment Ends

Standing Committee Named to Complete Unfinished Business and to Plan for Permanent Relief

After having made provision for the appointment of a standing committee to continue emergency unemployment organization and to appoint sub-committees for studying more or less permanent remedies for unemployment, President Harding's Unemployment Conference adjourned *sine die* October 13. The conference held three sessions during last week and was brought to a close after a resolution proposed by Secretary of Commerce Hoover was unanimously adopted providing for the appointment of a standing committee.

The duties of the standing committee shall be to continue the work and progress of emergency organization throughout the country and to convene sub-committees for future reports. The sub-committees provided for are (1) committees of service on the present emergency as may be required; (2) a committee on construction development; (3) a committee on remedial measures for reducing intermittent and seasonal unemployment; (4) and a committee on permanent measures of preventing unemployment. All matters undisposed of by the general conference are left to the standing committee.

REPORT ON MANUFACTURING

Though the general conference accepted various reports offering both emergency and permanent relief from the unemployment situation, the majority report of the committee on emergency measures by manufacturers was not accepted, though it was included in the record of the conference. Inasmuch as there was so much adverse criticism of the majority report by minority members of the committee, it was deemed inadvisable to accept the report because of its controversial nature.

In the public hearing before the public works committee on government reclamation the conference heard various pleas from local public bodies and officials urging the completion of this and that reclamation and irrigation project. The conference also learned that were sufficient appropriations for the reclamation work available, the U. S. Reclamation Service could employ directly 44,000 men during the winter and indirectly an additional 44,000. Mr. Ottomar Hamerle, Acting Director of the Reclamation Service, stated that $16,000,000 could be economically spent during the winter on irrigation projects already underway in seven states, which would give employment to 16,000 men directly and as many more indirectly in furnishing construction materials, etc., if a loan for reclamation funds were authorized by congress. He asserted that $28,000,000 additional could be immediately expended on irrigation and reclamation projects in the western states were a loan made to the fund.

Faulty Design Responsible for Destruction of Dirigible

After the coroner's jury, sitting on the destruction of the giant dirigible ZR2 at Hull, England, in August, returned a verdict finding that nobody was to blame for the accident, a court of inquiry for the British Admiralty has now reported that faulty design was to blame. It states that the design should have been but was not reviewed by an official committee before construction began, that "utmost economy in design" had been a governing consideration, that necessary aerodynamical information with respect to structural strength was lacking, that a quick reversal was being made at the time of the accident, bringing a heavy strain on the rear part of the hull due to the swing of the stern, and that the structure failed to the rear of the after-engine car, causing the vessel to break in two while 1,200 ft. high. The results of fuller investigation now in progress are to be made public in due course.

Colorado Highway Work Held Up

Failure of Colorado state officials to sell highway bonds authorized by vote has resulted in a reduction in the engineering staff by one-third and elimination of some of the large road gangs. Early construction on some projects next year will be hampered because of the lack of plans and surveys. Major L. D. Blauvelt, state highway engineer, has appealed to the citizens to buy bonds over the counter. They are in denominations of from $50 to $1,000 and bear 5 per cent interest.

Railroad Division of A. S. M. E. to Discuss Waste Elimination

The Railroad Division of the American Society of Mechanical Engineers will discuss the elimination of waste on railroads in connection with the general consideration of that topic at the annual meeting of the society. Papers to be presented include discussions of avoidable waste in locomotives as affected by design, in operation of locomotives and of cars. The meeting is to be held at the Engineering Societies' Building, New York City, the morning of Dec. 9.

Am. Soc. C. E. Board Holds Quarterly Meeting

Character Annual Meetings of Society Changed—Recommend Secretary Visit Local Sections

Passage of resolutions changing the character of the annual meeting of the society so as to make it more technical, instructing the finance committee to include in the 1922 budget an item for covering the expenses of the secretary in visits to local sections, instituting a card index system of keeping a professional record of all members, the passage of other resolutions, and the election of honorary members and the approval of new sections were the chief accomplishments of the Board of Direction of the American Society of Civil Engineers at the meeting held October 10 and 11 at the Engineering Societies Building, New York City.

Though the annual meeting of the society, held in January, is still to retain its social features, there are also incorporated in the tentative program technical discussions. The plan now proposed is to hold a conference lasting for the better part of two days on national transportation problems.

OTHER RESOLUTIONS

By another resolution the secretary of the society is to visit each of the local sections of the society each year, and be reimbursed for his traveling expenses. The Board of Direction instructed, through a resolution, the finance committee to include in next year's budget an item covering such expenditure.

Acting upon the recommendation made at the June 6 meeting the Board of Direction resolved to compile a card index system incorporating a complete professional record of all members of the society. The cards are now being printed and blanks will be circulated shortly so that by the first of the year the record will be full and up-to-date. It will be open to public inspection at the offices of the society in the Engineering Societies Building.

Three new honorary members were elected: Howard Adams Carson, of Boston; Luigi Luiggi, of Rome; and Charles Prosper Eugene Schneider. A resolution was also adopted which directs that, probably at the annual meeting, certificates be presented these men and the two elected at the last quarterly meeting of the board, accompanied by suitable ceremony. Ambrose Swasey and Samuel Rea are the honorary members elected in June.

The formation of two new sections of the society were approved by the

board. They are the Northeastern Section, Boston, and the Sacramento (Cal.), Section. Formation of student chapters at Bucknell University, University of North Carolina and West Virginia were also approved.

Among the other resolution passed by the board were those: (1) Approving the report of the joint committee composed of representatives of the American Institute of Architects, the American Engineering Council, the Federated American Engineering Societies and the Associated General Contractors of America upon a definite plan for quantity survey and payment for estimating; (2) approving the report of a special committee that recommended the society urge Congress to pass legislation which would give commissions to sanitary officers in the Public Health Service on the same basis as they are given in the Medical Corps of the army; and (3) urging Congress to appropriate an adequate sum to carry on highway research.

Market For California Irrigation Bonds Improves

During September and early in October there was notable improvement in the demand for California irrigation bonds; the current prices of this class of securities showing marked advancement. Bonds of the Turlock and Modesto irrigation districts bearing 6 per cent interest are now selling above par.

In commenting on this situation the financial editor of a San Francisco newspaper states; "When it is considered that there are now about $40,000,000 in obligations of California irrigation districts organized under the amended Wright Act now outstanding, and fully nine-tenths of which are held in this state, it is obvious that an upward trend in the prices of such issues, not only strengthens California's financial position but makes it possible for districts to finance new construction at lower rates of interest."

Fall Lettings of Contracts Favored by Many State Highway Engineers

Additional Replies Received to "Engineering News-Record's" Inquiry as to Policy Adopted for Early Award of Next Season's Construction

In answer to its inquiry regarding the policy adopted by the states in regard to the fall letting of road contracts "Engineering News-Record" has received from state highway engineers the following replies which supplement those published in last week's issue:

Vermont—"We are preparing for a fall letting. It is the policy of the State Highway Department to let as much of the 1922 work as early as it is practicable to get ready for such letting. We believe the policy of early letting is sound and highly desirable from the point of view of State's interests."—*By Thurman W. Dix, State Highway Commissioner.*

New Mexico—"The New Mexico Highway Department is endeavoring to relieve the unemployment situation as much as possible by letting contracts as fast as we are able to make the field surveys and build plans covering said road projects."—*By L. A. Gillett, State Highway Engineer.*

Iowa—"For the past two years, ever since the program of developing our primary road system was undertaken, we have pursued the policy of letting contracts in the fall for the next season's work. It is our judgment that the letting of contracts in the fall very greatly facilitates the progress that can be made during the next season."—*By F. R. White, Chief Engineer, State Highway Commission.*

Illinois—"In my judgment the best policy as to the time for awarding contracts on a large scale varies from year to year, depending upon general conditions. I am speaking, of course, from the point of view of the owner or builder. Ordinarily the contractor, who has perhaps 50 per cent or more of the road equipment needed for a given job, is able to secure the balance of the equipment and be ready to start work in approximately 60 days. This would indicate that in this latitude and as far as the contractor's ability to start work at the beginning of the season is concerned, the award of contracts in February or March would be satisfactory.

"Such an arrangement would not, of course, enable equipment manufacturers to forecast very definitely the demand for the next season's construction and they would be obliged to use less definite data in anticipating the demand and manufacturing equipment during the winter months. The advantage of the earlier knowledge of the demand for equipment might easily be offset by labor and material conditions, which cannot definitely be foreseen six months in advance.

"In regard to letting contracts for grading and bridge work, we consider it desirable to complete grading and bridge work as an independent operation at least six months or a year in advance of paving construction. This is particularly desirable where relocations are made and where the road is to be constructed through rough country. The object of such procedure is two-fold: First, a paving contractor is required to provide equipment for one class of work only and there is no danger of his operations being hindered or delayed by failure to complete one or more bridges which may be located over streams where flood hazard is to be con-

(Continued on next page)

Buffalo, Rochester, Syracuse Hold Joint Engineering Conference

Discussions upon the civic responsibility of the engineer, flood abatement work in northern New York, and the usual municipal engineering problems were chief among those heard at the tri-city conference held under the auspices of the Rochester Engineering Society Oct. 14 and attended by engineers from that city, Buffalo, and Syracuse. The chief speakers at the morning and evening sessions were George H. Norton, city engineer of Buffalo; Henry C. Allen, city engineer of Syracuse; Glen D. Holmes, chief engineer, Syracuse Sewer Commission; A. E. Lindau, president, Engineering Society of Buffalo; and S. B. Storer, first vice-president, Technology Club, Syracuse.

Mr. Storer in discussing the relation of the engineer or technical man to civic life decried the fact that engineers often carried out their duties only with a fidelity to their purely technical training. He emphasized the necessity for the technical man to grasp all the factors back of an engineering development.

Mr. Lindau outlined the evolution of engineering, asserting that fifty years ago but two kinds of engineering—military and civil—were known and that now so many existed that it was possible for one engineer to attend a meeting of a different type, and be unable to understand the topics under discussion.

Flood abatement work along the Buffalo River and that along Onondaga Creek were subjects treated by Mr. Norton and Mr. Holmes, respectively. Sewage disposal problems were also included in the discussion of each.

Of principal interest in the discussion given by Mr. Allen was the proposal of the City of Syracuse to move the New York Central R.R. tracks from their present position to the bed of the abandoned Erie Canal, thus eliminating grade crossings.

During part of the evening session the meeting was turned over to C. Arthur Poole, city engineer of Rochester, who called for an open discussion, which followed upon various routine municipal engineering matters.

The afternoon was spent in an inspection of the new garbage reduction plant in Rochester, the sewage disposal plant, the Barge Canal harbor, and other points of engineering interest. The board of governors of the Rochester Engineering Society were hosts to the visitors at a dinner in the evening served at the University Club.

Commission-Manager Plan in Effect at New London

The newly elected commission under the recently adopted commission-manager form of government took office at New London, Conn., Oct. 3. A city manager will be chosen by the commission.

(*Continued from preceding page*)

sidered. Second, it makes more certain a satisfactory job of paving inasmuch as fills, especially adjacent to bridges, may have sufficient time to become consolidated.

"In grading work the rail transportation of materials is of but little importance. I am therefore of the opinion that it does not make much difference as to the time of year contracts for such work are awarded, providing judgment is used. Naturally, contracts for very heavy work that may require an entire season for a certain type of grading outfit should be awarded sufficiently early to enable the whole season to be utilized. In highway work, however, where many sections of grading work occur that do not require more than perhaps a few weeks or a month to complete, it is an advantage to the contractor to distribute the award of such work throughout the season, in order that outfits that have completed elsewhere may be employed the full season.

"With this in mind, the Illinois Division of Highways endeavors to award during the winter or early spring heavy grading contracts, requiring a whole season's operations. It is the practice further to award contracts for lighter work at any time during the spring or summer when it is known that contractors, who are able to finish the work during the season, are available.

"From the point of view of the state, it is my opinion that the awarding of contracts in the fall, in preference to the spring, must largely be based on an estimate of labor and material conditions which may prevail during the early part of the succeeding construction season. In view of the present large supply of labor it would seem very desirable to let contracts this fall in order that work may be started in the spring as early as weather conditions will permit. Illinois is following this policy. On Oct. 4 we received bids for 185 miles of road work, awards for which will probably be made immediately. It is expected that we will continue to advertise additional work up to the first of the year."—*By Clifford Older, Chief Highway Engineer.*

Virginia—"The idea of fall lettings of contracts appeals to me very strongly. We have let quite a number during the month of September and will let more in November, totaling, however, a comparatively small amount, approximately $2,000,000. The situation in this state is unfortunate in that we are dependent on our General Assembly for appropriations for highway construction. The Assembly meets in January and February, making it impossible for us to carry out a policy of fall lettings."—*By George P. Coleman, State Highway Commissioner.*

Michigan—"I regret to have to advise you that Michigan has used all of its available funds for contract work during the road-building season of 1921. Since our next fiscal year begins July 1, 1922, there will be no more state bond money available until that time and hence it will be impossible to let contracts for 1922 work before next spring.

"I am in sympathy with the movement to give as much employment to labor as possible during the dull months of winter but our hands are tied and we can not do more than we have done. We have had a record-breaking road-building season, and it is safe to say, counting state and county work, that fully three times as much road building has been done during 1921 as in any previous year."—*By Frank F. Rogers, State Highway Commissioner.*

Florida—"Florida is just beginning to let contracts for road and bridge work for the remainder of this year and the fore part of next. Within the next three months it is hoped that we may be able to place from $2,000,000 to $3,000,000 worth of work under contract. It will be our endeavor to have all of this work advertised between now and Jan. 1, 1922."—*By Charles A. Browne, State Highway Engineer.*

State Highway Engineers Announce Policies on Fall Lettings of Next Year's Road-Building Contracts.

Montana—"In regard to the policy of letting contracts for next year's highway program this fall, please be advised that our program is not sufficiently outlined at this time so that we can proceed with a systematic award of contracts for next year's work. We are, however, proceeding on the policy of advertising projects as rapidly as they are ready for construction."—*By H. C. Kuhl, Principal Assistant Engineer.*

Arkansas—"In Arkansas no definite policy has been outlined for the letting of contracts this fall. Because of the low value of Arkansas bonds practically no new work is contemplated in the near future, so the early letting of contracts is not under consideration.

"The vast amount of unfavorable and exaggerated publicity that has been given the Arkansas road situation by the eastern newspapers has so depressed the bond market as far as Arkansas Road Improvement District bonds are concerned that it is impossible to sell these bonds for anything like a reasonable price. This condition has forced a number of districts that have authorization for additional bonds to suspend construction and leave the work in an unfinished state. It has also prevented the progress of a number of new projects that are ready to go ahead and has practically forced the abandonment of all new work.

"However, Arkansas has under way the construction of approximately 4,500 miles of improved roads, all let to contract and the work is progressing satisfactorily and rapidly. It is expected that 1,800 miles of this program will be completed by Jan. 1, 1922."—*By G. Hunter Sykes, Acting State Highway Engineer.*

Recommend Consolidation of All Government Mapping

Hydrographic, Topographic, Geodetic, Cartographic, Map Reproduction, Cadastral Branches United

Consolidation of all the general surveying and mapping work of the federal government in a new bureau under a single directing head has been recommended to the President by the Board of Surveys and Maps of the federal government. It is believed that this will reduce duplication to the minimum, will lower the unit cost of the work and will permit the government to meet the mapping and surveying needs of its own agencies and of the general public in a more effective manner. The action was taken on recommendation of the Board's committee on co-ordination.

The recommendations contemplate the consolidation in the new bureau of the U. S. Coast and Geodetic Survey of the Department of Commerce; the U. S. Lake Survey of the War Department; the U. S. Hydrographic office of the Navy Department; the topographic branch of the U. S. Geological Survey and the surveying and mapping activities of the General Land Office. The latter two bureaus form a part of the Department of the Interior. There are thirteen other organizations which are doing certain kinds of surveying and mapping. A part of this work can be taken over by the new bureau, if it is established, but certain amounts of surveying and mapping necessarily will continue as an incidental activity connected with the major work of some of those bureaus. Extracts from the committee report as amended and adopted are as follows:

ADVANTAGES IN UNIFIED BUREAU

"The advantages to be derived from such a consolidation may be summarized as follows: (a) The entire subject of surveying and mapping could be considered as a whole, the demands of the different interests weighed and adjusted, and a project drawn up to meet systematically and expeditiously the needs of the entire country in the most economical manner. Based on this project, estimates could be presented to the Bureau of the Budget by a single agency with greater prospects of success in securing the understanding and support of that Bureau and of Congress; (b) Such overlapping of work and duplication of effort as may now exist would be eliminated; (c) A considerable saving in overhead expense, in field operations, in the procurement of supplies and equipment, in map reproduction, and in map compilation, would probably result.

"The disadvantages to be considered in connection with a consolidation of mapping agencies are: (a) The danger that there will result and unwieldy organization, unable to make the prompt and sympathetic response to special needs that can be expected from a group of smaller agencies, each created to meet a special need; (b) The

existing services are located in several buildings, so that difficulty would result in securing a smooth running organization, unless provision could be made for housing all under one roof; (c) Some of the existing services are closely linked with other activities which will be more or less disturbed during the transition period.

"The committee therefore recommends the creation of a Bureau of Surveys and Maps in some existing or new department. This bureau should comprise six major branches, or divisions, and should perform the primary surveying and mapping functions of existing Federal agencies, under six branches, as follows: Geodetic, Topographic, Hydrographic, Cadastral, Cartographic and Map Reproduction."

Pontoon Bridge Project Abandoned by Its Promoters

Abandonment of the plan to build a pontoon highway bridge over the Hudson River at Yonkers, N. Y., was announced last week by George A. Post, president of the Hudson River Bridge Corp. The step is said to be chargeable in part to the unexpected amount of opposition to the proposed construction which developed at the hearing before Col. E. A. Burr, U. S. District Engineer, and in part to a demand made by the Shipping Board that the corporation purchase immediately the fifty wooden ships which it planned to use as pontoons for the bridge. The ships were to be bought for $2,400 each, requiring an investment of $120,000 whose usefulness would have remained contingent on authorization by Congress and the War Department for construction of the bridge.

Dabney Heads Tennessee Engineer License Board

The Tennessee board of architecture and engineering examiners, held a meeting in Nashville Oct. 1 and organized by electing A. L. Dabney, of Memphis, chairman, and Henry C. Hibbs, of Nashville, secretary. The board is now prepared to receive applications for license, for which the fee is $25 and the annual renewal $5.

The other members of the board of examiners, appointed by the Governor, are: Engineers: Dr. Charles S. Brown, Vanderbilt University, Nashville; and Prof. N. W. Dougherty, University of Tennessee, Knoxville. Architects: Bayard S. Cairns, Memphis; and W. H. Sears, Chattanooga.

Joint Committee Report For Sale

Copies of the recent progress report of the Joint Committee on Concrete and Reinforced-Concrete, giving specifications for concrete and reinforced-concrete, under discussion by the five societies concerned, are available from E. M. Chandler, acting secretary, American Society of Civil Engineers, 33 West 39th St., New York City, at 50c. each.

Great Falls Power Development Started at Winnipeg

Work has been started on the construction of the Great Falls dam and power house on the Winnipeg River for the Winnipeg River Power Company. On Oct. 1, 1921, the owners entered into a contract for the construction work with Fraser, Brace, Ltd. of Montreal and New York, and the Northern Construction Co. of Winnipeg which company had already started preliminary work at the site.

The work contemplates a dam 3,000 ft. long and a power house ultimately to produce 168,000 hp. The initial installation will comprise the dam and power house substructure complete with a power house superstructure for three units of 28,000 hp. each and an installation of two turbine and generator units of 28,000 hp. each. About 70,000 cu.yd. of rock excavation and 176,000 cu.yd. of concrete are involved in the construction of dam and power house. A rock cut of 240,000 cu.yd. two and half miles below the power house for lowering the water level in tailrace, an earth dike of 105,000 cu.yd. for confining the river at its new level above the power house and a steel tower transmission line to the company's old power house eighteen miles up the river form a part of the scheme.

The power which will be developed by this plant is to be utilized in Winnipeg and vicinity by the Winnipeg Electric Railway Co. and local industries the old plant of the Winnipeg River Power Co. being inadequate for the present demand. It is expected that by the time the initial development of 56,000 hp. has been completed the market for power in the Winnipeg district will justify the installation of other units. The first installation contemplates an expenditure of about $7,000,000 and will require 2 years to complete.

Opposition to Highway Bill Appears in House

(Washington Correspondence)

Decided opposition to the highway bill from New England and eastern members has developed in the House of Representatives. An effort is being made to prevent the granting of a special rule. Such a rule is necessary before the House can vote upon the appropriation that will be required. As this is written the consensus of opinion is that the rule will be forthcoming, but as the appropriation is new legislation and therefore subject to a point of order, the failure to secure the rule would mean an indefinite delay to the bill.

W. C. Markham, secretary of the Kansas Highway Commission, who has spent seven months in Washington representing the American Association of State Highway Officials, believes that the obstacles will be overcome and that the federal government, by the approval of this bill, will establish a regular highway policy.

30-Ton Gantry Crane Blown Off Pier

During a terrific rain and wind storm on Sept. 29 the 30-ton gantry crane on Pier 1, Lackawanna R.R., at Hoboken, N. J., was blown along the rails into the Hudson River. The accident is described as follows by M. H. Doughty, division engineer of the railroad.

"The crane is electric driven, using direct current 265 volts, delivered by contact boxes located adjacent to the running rails. It has a capacity of 60,000 lb. At a radius of 29 ft. the distance center to center of tracks for the gantry frame is 47 ft. 6 in. The crane is supported on four 4-wheel trucks which run over two running rails on each side of crane, the distance between centers of trucks being 25 ft. All movements are provided with automatic solenoid brakes operated by springs which apply the brakes to the motor shafts at the moment power is cut off.

"The crane travels along the length of the pier, about 900 ft. in east and west direction. On Sept. 29 there was a heavy rain, followed about four o'clock in the afternoon by an unusually high wind from the west. On account of the rain, operators had left the crane and had failed to put in place anchorages which had been provided to protect the crane in case of high winds, and they had also been operating the crane with the brakes on the motors on the traveling wheels blocked off so they were out of service. Under these circumstances the crane had nothing to prevent its moving down the track and it was blown off the end of the pier, falling into about 30 ft. of water.

"The crane was raised and placed on the dock by the Merritt & Chapman Wrecking Co., the work requiring about a week with one machine. Inspection of the crane indicated that the gantry legs were practically destroyed, with the exception of the trucks, the "A" frame practically destroyed and the boom was seriously damaged. The motors will have to be rewound and the various switchboards and controlling devices will have to be practically replaced new. The trucks and the various drums, gears, etc., are practically intact. A small number of boxes, a certain amount of shafting and minor operating parts will have to be purchased new. The total expense of putting the crane back in service is estimated at about one-half the cost of new crane of similar type to-date."

To Hold Road Congress in Spain

The Permanent International Association of Road Congresses, with headquarters in Paris, has accepted the invitation of the Spanish Government to hold its next meeting in Seville during the spring of 1923. The program, as at present contemplated, is divided into two parts, the first dealing with construction and maintenance and the second with traffic and motor transport.

Lackawanna Plans Electrification Both Ways From Scranton

Definite studies for the electrification of the Delaware, Lackawanna & Western R.R. east and west from Scranton are now being made. The system to be used has as yet not been decided upon. It is presumed construction will begin some time within the immediate future. Officials of the road say there is no foundation in the report that the Morris and Essex Division is included in the immediate program, studies having been made seven years ago and again but recently and in each case it was found electrification would be excessive as compared with steam operation.

Am. Soc. C. E. Meeting to Accord With Health Service Jubilee

Instead of November 2, the regular scheduled date, the first November session of the American Society of Civil Engineers will be held November 16 and 17 so as to harmonize with the annual meeting of the American Public Health Association. The program will be along sanitation lines, and symposia will be prepared on "Stream Pollution and Sewage Disposal," and "Water Supply and Water Purification." A paper on "Odors and Their Travel Habits," by L. L. Tribus, followed by a discussion, is also on the program.

New York Engineers' Club Honors Hoover

On Oct. 13 the New York Engineers' Club gave a reception in honor of Herbert Hoover, Secretary of Commerce. After the formal ceremony, Mr. Hoover, in response to a brief address by E. W. Kiddle, president of the club, spoke briefly about the work of the engineer and the significance in our industrial and social development.

Accident Records Used as Guide to Highway Improvement

In order to assist in properly determining the sections of roads to be improved, the Maryland State Roads Commission, under J. N. Mackall, its chairman and chief engineer, has arranged to have all accidents on the highways reported to it daily. Upon the receipt of each accident report a numbered colored pin is put in the proper location on a large map of the road system. Fatal accidents are marked with red pins, other accidents with yellow pins. The numbering of the pins, corresponding to index cards, enables one to trace back and find the character of each accident.

By keeping this record and marking the map bad stretches of road, on which accidents have been caused by too narrow a width or too much crown have been disclosed. In some cases the bad sections had not been listed as desirable for immediate improvement. The method, therefore, has proved effective in locating some of the danger spots.

Philadelphia Council Upsets Plan for Garbage Incinerator

The City Council of Philadelphia, on Oct. 6, repealed the ordinance for the construction of a garbage and refuse incinerator on Cambria St., in the 38th ward, under which bids were received Aug. 26. Opposition to the use of the site is responsible for the council's action. Bids for the incinerator—which have not been acted on, owing to the site controversy—were received from four contractors under two plans, each on a 24-hr.-day basis: (1) For a plant with a capacity of 140 tons of mixed refuse or 280 tons of rubbish only; (2) 480 tons of rubbish only. The bids were:

	Plan 1	Plan 2
Chicago Incinerator Co., Chicago	$41,940	$79,800
Krens Boiler Works, Toledo, Ohio	51,400	99,800
Decarie Incinerator Co., Minneapolis	75,100	142,800
Nye Odorless Crematory Co., Macon, Ga.	(no bid)	126,500

These bids were for an incinerator complete, with forced draft, but did not include foundations, chimney, and building.

Cement Association Engineers Meet in Washington

Engineers of the eastern districts of the Portland Cement Association met in Washington Oct. 12 to witness tests at the Arlington experiment station of the Bureau of Public Roads. Advantage was taking of the gathering to give a banquet in honor of A. N. Johnson, formerly the consulting highway engineer of association and now dean of the engineering college of the University of Maryland.

Industrial Relations Conference To Be Held at Harrisburg

A state industrial relations conference is to be held at Harrisburg, Pa., October 24-27 under the direction of Commissioner C. B. Connelley of the Department of Labor and Industry. The conference is to take the place of the annual safety congress. Men prominent in the various phases of industrial relations will be speakers at the several sessions.

Underwriters Plan Airplane Classification Work

R. W. Schroeder, holder of the world's altitude record (33,114 ft.), and until recently major, U. S. Air Service, and chief test pilot, McCook Field, Dayton, Ohio, will join the staff of Underwriters' Laboratories, Sept. 1, and will take a principal part in the airplane classification work which the laboratories are doing for the National Aircraft Underwriters' Association. The object of this work is "to secure the best and fairest opinion regarding the merits or demerits of every device, system, machine or material in respect to life and fire hazards."

Railroad Strike Looms as Roads Talk of Freight Reductions

With the announcement that the railroads of the country would seek from the Interstate Commerce Commission authority to reduce freight rates from 15 to 20 per cent, which reduction would undoubtedly be predicated upon further wage cuts, the Big Four railway brotherhoods and the Raliway Switchmens' Union, controlling some 2,000,000 transportation workers, announced last week a progressive strike order to become effective October 30 and to continue through four days until all roads in the country were tied up.

The strike order, according to union officials, is based upon the 12 per cent rate reduction ordered last July by the Railway Labor Board, though it is believed to be given now as a possible means of circumventing new wage reductions. Union officials declare the strike order will be carried out, though government officials hope to avoid it. The public group of the Railway Labor Board offers a plan whereby wage reductions ordered last July be immediately translated into lower rates which would probably lower living costs, thereby appeasing transportation employees.

Railway Claims to Extent of $387,000,000 Settled

Practically half of the claims of the railroads against the government growing out of federal control have been settled according to a report made recently to President Harding by Director General Davis of the Railroad Administration. Up to Oct. 1, an aggregate of $856,000,000 in claims had been filed by sundry carriers. Final settlement adjusted up to the same date aggregated $387,000,000. Practically all of the settlements have been made since Jan. 1. Claims filed represent 108,394 miles—78.71 per cent of the total mileage under federal control. If the remaining percentage of mileage should present claims on the same basis as those already filed the total claims against the Railroad Administration would aggregate in excess of $1,000,000,000.

Actual Property Value the Basis of Local Improvement Orders

According to a ruling in the Superior Court, the City Council of Seattle has the authority to order local improvements where the cost does not exceed 50 per cent of the actual value of property in the district. Heretofore, the city council has assumed the 50-per cent limitation was based on the assessed valuation, which is about half the actual value. The ruling was made in a recent suit brought by a property owner seeking an injunction to halt street improvement work, on the ground that the cost exceeded 50 per cent of the assessed valuation. E. C. Ewing, assistant corporation counsel, states that a Supreme Court review will be sought on the ruling.

Point Bridge Report Recommends Immediate Repairs

Restriction of traffic and immediate emergency repairs, followed by the earliest possible construction of a new bridge, are the chief recommendations of a board of engineers that has just reported on the Point bridge over the Monongahela River at Pittsburgh. The board, appointed by Norman F. Brown, director of public works, consisted of John D. Stevenson, T. J. Wilkerson, and C. S. Davis.

As the roadway of the bridge is only 20 ft. wide, which the engineers say is now wholly inadequate to accommodate traffic, and the suspension cables of the structure also are not capable of carrying unrestricted traffic safely, the report says that construction of a new bridge will be necessary and should be taken in hand at once. For present safety, traffic is to be restricted to 150-ft. spacing of street cars and the use of only one track, and exclusion of all trucks weighing more than 10,000 lb. total; at the same time, certain floor members are to be repaired and reinforced in order to make the floor safe under this restricted traffic. The cost of the repairs is estimated at $10,000. Should the recommended restrictions be found too severe to take care of traffic requirements during the construction of a new bridge, reinforcement of the entire floor system, at a cost of $50,000, will be necessary, and thereafter traffic can be operated under a restriction of 200-ft. spacing of street cars (on both tracks) and exclusion of trucks weighing over 13 tons total.

East St. Louis Drainage Board Cancels Canal Contract

A contract for the first portion of a drainage and flood protection canal along the foot of the bluffs at East St. Louis, Ill., has been canceled by the Board of Trustees of the East Side Levee and Drainage District for the reason, as reported, that the present benefit to taxpayers has not been proved. The contract was awarded by a former board in October, 1920, and the present board is said to have been elected in November of that year on the basis of opposition to the project. This canal, noted in *Engineering News-Record*, July 14, p. 56, was considered by the engineers of the flood protection project as a future supplement to a canal across the district, but the former drainage board decided to proceed with this work first.

Camden Creates City Plan Commission

A City Planning Commission has been created at Camden, N. J. Among the six members are Levi Farnham, city engineer, Martin Schreiber, superintendent Public Service Railway Co., and E. H. Sapp, of the New York Shipyard. The other commissioners are members of the City Council.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

The Washington Irrigation Institute, at its annual meeting in Yakima, Oct. 27-29, will be addressed on the following topics: "Program for the Irrigation Experiment Station," Dean E. C. Johnson; "A General Survey of Reclamation in the State of Washington," Joseph Jacobs; "Our Irrigation District Law—Can It Be Improved," Ralph H. Williamson; "Some of the Fundamental Facts Upon Which Rests the Development of the Columbia Basin," Prof. O. L. Waller; "Some Accomplishments and Prospects of the United States Reclamation Service," F. E. Weymouth; "Progress Under State Reclamation and Land Settlement Laws," Dan A. Scott; "Old Versus New Methods of Land Settlement," E. F. Benson.

The Kansas Section, Am. Soc. C. E., has elected the following officers: President, Prof. L. E. Conrad, Kansas State Agricultural College; vice-president, Prof C. C. Williams, Kansas University; secretary and treasurer, F. S. Altman, field engineer of the Portland Cement Association, Topeka, Kan.

The Pittsburgh Section, Am. Soc. C. E., at a meeting Sept. 19, with 15 present, passed the following resolution: "With due acknowledgment of the work of the committee, it is the sense of this meeting that the proposed revision of the constitution of the American Society of Civil Engineers be ejected."

The American Water Works Association announces the formation of a North Carolina Section, with J. L. Ludlow, Winston-Salem, as president. Prof. Thorndyke Saville, Chapel Hill, is secretary and H. E. Miller, State Board of Health, Raleigh, is chairman of the membership committee. A meeting in December, probably at Greensboro, is planned.

American Water Works Association, New York Section—At the first meeting of the season, held in New York City, Oct. 16, Col. Theodore A. Leisen, civil engineer, Detroit water-works, reviewed the growth and present program of the water-works of Detroit. In the past eight years, construction has about equalled all that had gone before in sixty years. From 1914 to 1921 there were laid 738 miles of water mains, of which 275 were laid in 1920 and 1921. Trenching and other machines have been used extensively. Included in the large amount of work in hand or projected is a filtration plant with a capacity of 320 to 350 m.g.d., which it is expected will be completed in 1922 or 1923.

Personal Notes

COL. F. F. LONGLEY, assistant director of the department of health, League of Red Cross Societies, Geneva, Switzerland, is leaving the service of the League in November and will go to Australia, where he will assist the newly created Ministry of Health in the organization and establishment of a department devoted to sanitary engineering. Col. Longley, prior to the war, was with the firm of Hazen, Whipple & Fuller, consulting engineers, of New York City. He entered the military service in 1917 as a major, Engineers, was ordered to France and became head of the water supply section of the Division of Military Engineering and Engineer Supplies of the A. E. F., with the rank of colonel.

F. C. WIESE is organizing the sales department of Amplex Incorporated, importers of S&N beam shears, balanced steel frame combination punches and shears and Hercules angle-bending machines. R. BAUER, formerly with Joseph T. Ryerson & Son, has been placed in charge of the New York metropolitan district.

COL. CHARLES KELLER took the oath of office as Engineer Commissioner of the District of Columbia last week and was selected as chairman of the Public Utilities Commission.

DON MACCRAE, senior member of Ford & MacCrae, consulting engineers, Little Rock, Ark., has been appointed consulting engineer for district 10, the Arkansas-Missouri Highway District and the Spring Lake District, Pulaski County, Ark.

DR. KENNETH G. MATHESON, president of Georgia College of Technology, has accepted the presidency of Drexel Institute, Philadelphia, Pa., and will assume his new duties in April, 1922.

FRANK L. BOLTON, formerly manager of the Erie office and district for Gannett, Seelye & Fleming, engineers, Harrisburg, Pa., has been appointed general manager of the Cayuga Rock Salt Co., Inc., near Ithaca, N. Y. This company is being operated under the management of Gannett, Seelye & Fleming.

GEORGE J. RICHARDS, formerly resident engineer, Mill Creek flood control project, Erie, Pa., for Gannett, Seelye & Fleming, Inc., engineers for the city of Erie, has been appointed manager of the firm's Erie office.

P. H. LONG, formerly designing engineer with the U. S. Steel Corp., is now in consulting engineering practice in Charlotte, N. C.

WILLIAM SHINGLETON has resumed his position as assistant engineer on the Chicago, Indianapolis & Louisville R.R., at Lafayette, Ind., after a three months' trip in Europe.

D. S. WATKINS has resigned as engineer of construction with the Buffalo, Rochester & Pittsburgh Ry. He has been connected with this road for 29 years and has been in charge of the developments in Western Pennsylvania.

STANLEY A. KNISELY has been appointed economist of the National Paving Brick Manufacturers Association. He was formerly on the staff of the Cleveland *Plain Dealer* where he specialized on business news.

RUDOLPH J. WIG has withdrawn from the engineering firm of Wig, Hollister & Ferguson, to devote all his attention to the Celite Products Co., of Los Angeles, Cal. Mr. Wig has been connected with this company for about a year and now has found that his duties on the Pacific coast will take all of his time. The company is engaged in the mining and conversion to various uses of celite, a diatomaceous earth occurring in large quantities near Lompoc, Cal. It is used for filtration and insulation mainly. Mr. Wig's place in the engineering firm has been taken by Wayne W. Light and the firm's name now will be Light, Hollister & Ferguson, Inc., Engineers, with office in the Land Title Bldg., Philadelphia.

OBITUARY

JAMES W. PIERCE, civil and constructing engineer, died recently in Wellesley, Mass. He was born in Cambridge, Mass., in 1870 and attended the Massachusetts Institute of Technology. For about three years he was rodman and transitman with the Board of Survey, Boston, and from 1894 to 1897 he was assistant engineer with the Massachusetts Highway Commission. From 1897 to 1900 he served as park engineer in the office of the city engineer, Cambridge. He also held the positions of superintendent of parks and later, city engineer of Cambridge. He has been conected, until recently, with Lockwood, Greene & Co., Boston, Mass.

DR. JOSEPH W. RICHARDS, professor of metallurgy at Lehigh University, died in Bethlehem, Pa., on Oct. 12. He was born in Oldbury, England in 1864. He was a graduate of Central High University, and taught at the latter institution for more than thirty years. He was a member of the United States Assay Commission in 1897 and of the United States Navy Consulting Board, 1915-1918. He was a charter member of the American Electrochemical Society, its first president in 1902 and 1903, and its secretary since 1907.

BUSINESS NOTES

THE CORTLANDT MACHINERY & EQUIPMENT CO., INC., has been organized with offices in New York City, and will specialize in the sale of saw mills, logging tools, wood-working plants and power machinery and is prepared to render full technical service to foreign purchasers and export firms. Maximilian Aviles is secretary and treasurer.

THE CANADIAN CHICAGO BRIDGE & IRON CO., LTD., Bridgeburg, Ont., and Montreal, Que., has changed its corporate name to Horton Steel Works, Ltd. The name has been selected in honor of the late Horace E. Horton, who founded the organization in Chicago in 1865. The Bridgeburg plant was constructed in 1913.

THE BLAW-KNOX COMPANY announces the addition to its staff of H. O. Davidson, formerly general manager of the Hydraulic Steelcraft Co., to have charge of the Prudential sectional building department, and also serve as general manager of the C. D. Pruden plant, with headquarters in Baltimore, Md.

HOMER W. SCOTT is now in charge of the Cleveland office of the Jeffrey Manufacturing Co., located at Leader-News Building, and C. R. Heller is in charge of the Buffalo office in the Marine Trust Building.

R. N. VANWINKLE, formerly assistant operating manager, France Stone Co., Toledo, Ohio, and assistant general manager, National Lime & Stone Co., Carey, Ohio, has purchased an interest in the Hawkeye Quarries Co., Cedar Rapids, Iowa, and has been made general manager of the company.

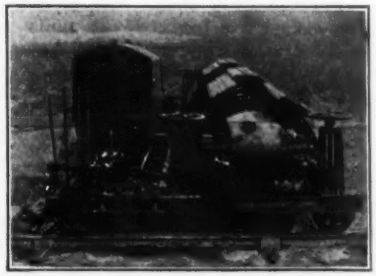
SIDNEY G. DOWN, for the last ten years Pacific district manager of the Westinghouse Air Brake Co. and president of the Westinghouse Pacific Coast Brake Co., has been appointed general sales manager of the Westinghouse Air Brake Co., with headquarters at Wilmerding, Pa. He will also be in general charge of sales for the Westinghouse Traction Brake Co.

N. DEWIND, formerly connected with the Austin Manufacturing Co., is now with Mussens, Ltd., agents for railway, mining and contractors' supplies, Montreal, Can., with headquarters at the Toronto office of this company.

EQUIPMENT AND MATERIALS

One Man Subgrader

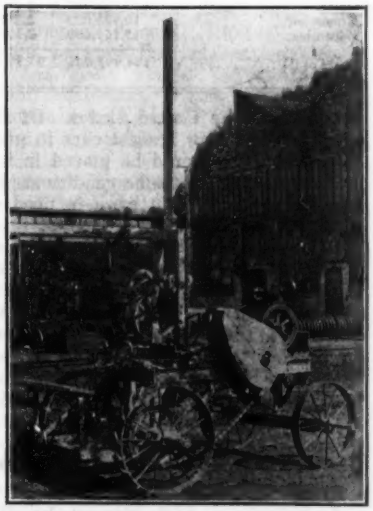
A one-man, gasoline-operated subgrader, drawn along on the road forms by means of cables, is a recent addition to the road equipment manufactured by the Austin Machinery Corporation. The subgrader has 4-ft. digging buckets equipped with removable steel plow lips, which are set to drive in five distinct places to depths varying from 2 to 4 in. In trimming the road, two plows shave



off the sides between the forms and the buckets. The buckets then trim the road depositing the excavated material on the 15-in. conveyor belt, which discharges the surplus material outside the forms. One passage over the road leaves the subgrade in condition for laying the concrete.

Power Tamper

A number of new features are incorporated in the latest model P&H power traction tamper made by the Pawling & Harnischfeger Co., Milwaukee, Wis. In this new tamper all chains and gears are supplied with enclosing guards. The tamper and steering cables used are ⅞ in. in diameter instead of ¾ in., and the new type



traction wheels are furnished with extension axles to allow for changing the tread from 58 in. to 76 in. The standard tamping head is 150 lb. in weight as before. Only one man is required to operate the tamper, the control of the power ram and the forward and backward movement of the tamper being readily accomplished from the operator's seat.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Southern Pine Orders Still Grow

For the week ended Friday, Oct. 7, the orders received by 127 mills reporting to the Southern Pine Association totaled almost 95,00,000 ft. b.m., 37½ per cent above the production for the week. The shipments during the week amounted to approximately 82,000,000 ft. b.m.,—19 per cent above the production for the week—leaving the orders on hand at the end of the week 298,000,000 ft. b.m., in round numbers. The total orders for the week were 10 per cent in excess of the normal production. The shipments below normal production were 4½ per cent and production 20 per cent below.

Idle Freight Cars Fewer

The number of freight cars idle because of business conditions, totaled 375,370 on October 1 compared with 414,698 on Sept. 23 or a reduction of 39,328 according to reports just received by the car service division of the American Railway Association from the railroads of the United States. Of the total 172,420 were freight cars in good condition which could be placed in immediate service if traffic conditions demanded while 202,950 were in need of repairs.

Reports showed that the number of surplus cars in serviceable condition on October 1 was a reduction of 28,733 compared with the total on the previous date. Of the 2,306,036 freight cars on line on October 1, reports showed 364,372 to be in need of repairs or 15.8 per cent compared with 374,431 or 16.3 per cent on September 15.

Road Work in California Costing $300,000 Weekly

A bulletin recently issued by the California Highway Commission states that expenditures in connection with state highway construction are now exceeding $300,000 per week. "The recent sale of highway bonds" the bulletin states "has permitted the inauguration of a construction program involving a rate of expenditure in excess of that during any previous period of highway construction."

Construction Volume Index Number Compiled

Engineering News-Record Establishes Index Which Gives True Picture of Present Volume Compared With 1913

To get a true picture of the condition of the construction industry it is necessary to know how both costs and volume of construction compare with similar figures of other periods. *Engineering News-Record*, since July, has been satisfying the first of these needs by giving its readers a comparison of costs, through the *Engineering News-Record* Construction Cost Index Number. There remains now to give a similar picture of the volume of work, and this will be accomplished by the establishment and regular publication of the *Engineering News-Record* Construction Volume Index Number.

This new index number which will be published regularly in the first issue of every month, will give a true comparison of construction activity at the minute with that of the now commonly accepted reference year, 1913. This will be done by determining the volume of work that could be bought with present contract totals on the basis of 1913 prices. The contract values for 1913 and for the current year are reduced to comparable terms by use of the *Engineering News-Record* Construction Cost Index Number.

The determination of the basis for this comparison entailed a great amount of labor, but it is believed that the resulting benefit to readers of *Engineering News-Record* has justified the time and expense. The money value of all important engineering construction contracts awarded for all classes of work in 1913 has been determined and also for the year 1921 to date. The figures for 1913 and for 1921 to date are given in the accompanying table and in themselves are a valuable compilation.

In actual procedure the volume index number is secured by determining what amount of money in 1913 would have been sufficient to buy the construction corresponding to total amounts appropriated for current work. This figure is then compared with the total amount of money appropriated for construction in 1913. This can be expressed as a simple equation as follows:

$$\text{Vol. Index No.} = \frac{\text{Cost Number for 1913}}{\text{Cost Number for 19xx}} \times \frac{\text{Value Contracts Let 19xx}}{\text{Value Contracts Let 1913}}$$

The year 1913 was selected as the base because it is the last pre-war year, and because practically all cost index numbers (including the *News-Record's*) are referred to that year. As a matter of fact it was not a normal construction year, either in total volume or in distribution, and plotting the monthly totals (last column of Table 1) will not give the characteristic curve of a normal construction year. For that reason it will not to do to compare a fraction of say 1921 with the same fraction of 1913. If the monthly volume index number were calculated on this basis (January, February, etc., 1921, compared with January, February, etc., 1913) the result would be erratic and incorrect. To obviate such error, the average monthly contracts let in 1913 forms the basis for computing the monthly volume index number.

To put it as a formula, let C_1 represent the contracts awarded in the month for which the volume index number is desired, C the 1913 average monthly value of contracts, I, the cost index number for the C_1 period, and I the 1913 cost index number. Then

$$\text{Vol. Index No.} = \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But I and C are constants — 100 and $57,545,000, respectively; therefore,

$$\text{Vol. Index No.} = \frac{100\,C_1}{57,545,000\,I_1} = \frac{C}{575,450\,I_1}$$

TABLE I. CONTRACTS LET IN 1913 ON ALL CLASSES OF CONSTRUCTION AS REPORTED BY ENGINEERING NEWS-RECORD

1913	Railways	Bridges	Water Supply Irrigation	Sewers	Streets and Roads	Industrial	Fed. Govt.	Buildings	Miscellaneous	All Class
January	$15,896,575	$2,183,349	$2,537,857	$2,601,466	$1,792,673	$2,037,758	$505,182	$9,833,166	$6,595,426	$43,983,452
February	15,550,000	767,239	1,167,714	2,722,937	1,971,145	1,675,824	1,122,341	7,127,486	4,361,884	36,466,570
March	25,561,555	2,246,544	923,470	1,824,693	4,218,836	3,975,636	6,473,938	11,223,293	21,779,491	80,217,455
April	19,900,000	617,033	744,897	2,131,058	3,212,460	7,976,676	2,173,268	7,563,153	7,182,464	51,501,009
May	23,383,295	923,479	2,988,265	3,281,660	6,670,252	6,282,405	837,063	24,937,849	3,141,655	62,445,923
June	7,338,080	5,393,729	1,631,718	2,828,831	5,950,707	14,294,249	1,987,220	12,698,420	2,588,938	54,711,892
July	37,550,000	1,257,028	6,335,307	2,338,361	4,810,197	2,422,470	3,460,169	20,075,028	16,543,420	94,791,980
August	6,130,000	1,556,085	1,682,169	1,099,440	3,769,566	1,675,546	3,356,282	11,453,034	2,946,149	33,668,271
September	1,810,000	2,391,935	1,784,768	1,646,049	3,150,418	1,634,685	7,212,138	11,187,289	24,968,911	55,786,193
October	17,787,500	1,257,003	1,789,466	2,479,178	5,531,483	3,070,564	3,502,491	14,242,257	16,357,939	66,017,881
November	10,925,000	2,299,305	690,326	1,524,873	3,381,836	2,274,114	3,695,128	16,238,030	6,667,198	47,607,812
December	13,165,000	2,398,201	2,097,043	2,425,593	4,112,041	1,784,372	3,079,969	12,108,646	22,169,940	63,341,205
Total	194,997,005	23,290,930	24,373,000	26,906,539	48,471,616	49,104,299	39,405,189	148,687,651	135,303,415	690,539,644

For example, contracts let in August, 1921, amounted to $104,644,115, and the cost index number was 193.07. Hence the volume index number is

$$\text{Vol. Index No.} = \frac{104,644,115}{193.07 \times 575,450} = 94$$

This means that in August of this year the volume of work placed under contract was 94 per cent of that placed in the average month of 1913. The figure thus gives a picture of the construction activity of today compared with the activity in the commonly accepted reference year, 1913.

The comparison of the individual lettings in any one month, of course, is not indicative of the volume of work actually under way, since this volume is the sum of all jobs let over, say, nine or twelve months. Consequently, a better comparison is afforded by the index number for the year 1921 to date. Comparing the first nine months of 1921 with nine months of 1913 it is found that the index number is 83, which means that to date this year only 83 per cent as much work, in volume, has been let as in 1913.

Side by side with the Construction Cost Index Number the Construction Volume Index Number will be published in the first issue of each month—the issue containing the monthly prices of construction materials and the rates paid labor and the current labor situation throughout the country. The two index numbers for the months of 1921 were as follows:

ENGINEERING NEWS-RECORD'S INDEX NUMBERS

	Construction Cost	Construction Volume
1913	100.00	100
1920	238.79	...
1921 (nine months)	211.63	83
January	230.87	41
February	230.67	43
March	224.27	88
April	213.07	86
May	210.82	90
June	209.82	117
July	203.82	90
August	193.07	94
September	188.27	114

Unemployed in Texas to do Road Work

Texas has made plans to carry on highway work throughout the winter, in order to help the unemployed. Rollin Windrow, state highway engineer, expects to give employment to several thousand men during the fall and winter, by completing several million dollars worth of road work. If congress appropriates sufficient federal aid, it is expected that a far larger program than is now contemplated will be carried forward.

September Pig Iron Production

According to figures compiled by the *Iron Age* there was a further improvement in the production of pig iron during September. The total for the month was 985,529 tons for 30 days, a figure which compared with 954,193 tons in August. The increase in pig iron production in August compared with the preceding month was the first that had taken place in nine months. The September increase is consequently the second gain since the decline in production began almost a year ago. During September 1920 the pig iron production was slightly in excess of 3,000,000 tons and during September, 1919 approximately 2,500,000 tons. Steel corporation operations are now about 38 per cent of capacity. In the Chicago district the Illinois Steel Company is on about a 39 per cent basis and the Inland Steel Company 40 per cent.

Standard Oil Plans Work For Unemployed

According to present plans the Standard Oil Company of New Jersey will spend in the neighborhood of $2,000,000 for repairs and reconstruction at his main refineries in New Jersey in an effort to lessen unemployment. The work will provide employment for about 5,000 of the oil company's 10,000 employees now on part time or not employed at all, and will increase the weekly income about 25 per cent. The plan has been made possible by the acceptance on the part of the employees of the bonus elimination, a bonus of 10 per cent having been paid by the company since August, 1919. The three refineries upon which work will be extended are at Jersey City, Elizabeth and Bayonne.

Freight Rate on Road Materials Ordered Reduced in Ohio

Effective today substantial reductions in intra-state paving brick freight rates were recently ordered by the State Utilities Commission of Ohio. Sand and gravel also shared in the reduction but not to the extent of the consideration given paving brick rates. The ordered reduction restores rates on the foregoing materials to those in effect prior to Aug. 25, 1920. In addition, because, as indicated in the order, paving brick had received prior advances disproportionate to those given under competing materials, an additional reduction of 10 cents a ton is ordered on paving brick.

A. G. C. Plans Conferences to Stimulate Construction

In accordance with a recent program adopted by the executive board of the Associated General Contractors of America to stimulate construction as a means to lessen unemployment, several members of the executive board are soon to make extended trips through Western and Pacific Coast cities. Meetings of represenative citizens and general contractors have been arranged in the principal cities of the country and at these meetings W. O. Winston, president of the A. G. C., W. A. Rogers of Chicago, F. L. Cranford and D. A. Garber of New York, together with G. W. Buchholz, secretary, and E. J. Harding, assistant secretary of the national organization, will address these meetings in behalf of an aggressive program, both national and local, to start construction.

Central committees and general contractors in each of the cities will be appointed as nuclei of a permanent organization. Under the direction of R. C. Marshall, Jr., general manager of the A. G. C., this work has already been organized in from twenty-five to thirty cities covering in some instances entire states. From headquarters in Washington General Marshall is already working through national committees and general contractors on labor, materials, methods, contracts, insurance and bonds, transportation, codes, legislation, information, and statistics to bring about conditions which will make possible the carrying out of the construction program outlined by the President's conference on unemployment.

Local committees will be urged to secure the fall letting of public work and highway contracts. Other committees to secure adequate legislation for highway and water-power development will be recommended. Investigations in better methods of accounting and estimating and improved contract forms will be suggested. Close co-operation with the national headquarters in the entire campaign will be assured through monthly, weekly, and special bulletins and reports.

Relief Works for Unemployed Not Economical

(London Correspondence)

A large number of public works undertakings will probably shortly be commenced in Britain, chiefly for the purpose of alleviating to some extent the unemployment, which, at September

TABLE II. CONTRACTS LET IN 1921 ON ALL CLASSES OF CONSTRUCTION AS REPORTED BY ENGINEERING NEWS-RECORD

1921	Waterworks	Sewers	Bridges	Streets and Roads	Excavation	Industrial	Buildings	Federal Government	Miscellaneous	All Classes
January	$519,028	$3,146,948	$3,030,477	$11,597,810	$1,266,346	$12,881,968	$17,455,673	$2,071,141	$2,358,976	$54,328,367
February	2,927,307	2,445,075	885,529	12,049,344	305,740	4,737,850	31,902,608	1,574,927	1,728,441	56,556,821
March	2,028,055	2,862,131	1,443,060	25,880,109	1,625,690	15,032,130	56,520,231	3,590,617	4,231,823	113,213,846
April	3,342,150	3,817,401	1,987,808	31,026,312	580,039	9,346,586	51,647,900	1,186,403	2,732,799	105,667,398
May	4,943,562	2,162,460	1,642,894	35,064,031	2,631,799	7,799,584	48,442,471	1,809,588	4,408,142	108,904,531
June	3,494,584	3,802,040	2,417,632	56,772,257	1,240,398	6,111,307	56,576,768	4,158,430	6,005,398	140,578,814
July	3,105,969	3,985,991	5,053,520	33,942,893	609,233	6,781,369	45,452,153	3,382,964	3,696,957	106,011,049
August	2,404,304	3,988,318	2,353,227	28,692,878	89,403	7,210,378	50,475,001	1,355,545	8,075,061	104,644,115
September	1,487,296	5,063,990	3,405,876	23,256,996	9,025,229	13,259,789	60,979,116	3,694,113	3,301,392	123,473,797

2, amounted to 1,527,000 with 400,000 on short time. The public utility works suggested all take the form of road construction, dock extension and drainage schemes. Already various local authorities have voted large sums for relief works of this nature, and it is proposed that the Treasury shall guarantee the interest on all sums borrowed by local bodies. Such a proposal would eliminate too heavy a burden on the Exchequer, and would allow local authorities to raise the funds without the heavy imposition which the payment of interest entails upon the rate payers.

Hitherto the provision of artificially created work for the sake of relieving unemployment has proved anything but successful, and, if these new proposals actually materialize, great care must be taken that legitimate employment is not interfered with and the revival of trade impared. Experience has shown that it is far more economical to pay out small sums, sufficient to meet minimum expenses, to unemployed, than it is to provide them with relief works which, in many cases, have resulted in chaotic financial and trade conditions.

September Shows Decrease in Retail Food Costs

According to figures compiled by the Bureau of Labor Statistics, the retail food index shows a decrease of 1.1 per cent in the retail cost of food to the average family in September as compared with August. Forty-three articles of food are used in the compilation and prices are received from fifty-one cities throughout the United States. During the year ended Sept. 15 the percentage decrease in all articles of food combined was 25 per cent.

Little change in the general level of wholesale prices in September as compared with August is indicated. The Bureau's weighted index number computed from 327 price series is 152 for September, the same as for August.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 6, the next, on November 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.88	$4.00	$4.00	$2.88	$3.16	$3.75	$3.70	$3.75	$4.00
Structural rivets, 100 lb	3.70	5.25	5.50	3.68	4.15	4.25	5.50	5.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.78	3.20	3.50	2.78	3.18	3.57½	2.35	3.75	3.75
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52.65–5%	45%	65½%	58.9–5%	38%	51.8%	55%	5%
Cast-iron pipe, 6 in. and over, ton	45.30	40.50	54.30	—45.60	47.80	52.00	—50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	—2.40	2.69	2.55	1.97	2.26	3.10	2.84	3.10	3.10
Gravel, ¾ in., cu.yd	2.00	2.13	2.25	1.65	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.35	2.25	1.65	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.80 to 1.90	2.25	3.20		2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	+38.00	35.00	48.00	+36.00	50.00	29.00	+24.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	25.40	27.50	21.00
Lime common, lump, per bbl	3.69	1.60	2.75	—1.40	1.40	2.95	1.90	2.75	15.00
Common brick, delivered, 1,000	18.90@19.40	+11.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	+.14	.124	.0821	.092	.09	.12½	.10	15
Hollow partition tile 4x12x12, block	.11370	+.14	.124	.0657	.092	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.73	.86	.93	.81	+.81	.93	.83	.79	.90
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	.72½	.50	.50@.55	.75	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Cement delivered to contractors** on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

Changes Since Last Week

Pittsburgh quotes mill prices on structural steel shapes at $1.60@$1.75; plates at $1.55@$1.65; and reinforcing bars at $1.50@$1.65 per 100 lb. Mill shipments, New York, of steel shapes and plates are quoted at $1.98@$2.13; and bars at $1.98@$2.03 per 100 lb. Denver quotes mill shipments of structural shapes at $3.05; warehouse price, $3.75 per 100 lb. Chicago quotes cast-iron pipe at $45.60 as against $44.10@$46.10 per ton.

New York quotes cement at $2.40 as against $2.50 per bbl., delivered. Decreases in cement prices are reported in three Western cities. Peoria quotes cement to contractors in carload lots, f.o.b., without bags, at $2.14 as against $2.25; Cedar Rapids at $2.28 as against $2.31, and Davenport at $2.22 as compared with $2.27 per bbl. formerly. Chicago shows a reduction of 15c. in crushed stone, making the present price $1.60 as compared with $1.75 per cu.yd. previously.

An advance of $2 per M. ft. b.m. is reported in Douglas fir, base sizes, in Minneapolis and Seattle. Chicago quotes common lump lime at $1.40 as against $1.50 per bbl., 180 lb. net. Common brick has advanced $1 in Atlanta, making the present price $11 as compared with $10 per 1,000 formerly.

Linseed oil has advanced 3c. in Minneapolis and declined 3c. per gal., 5 bbl. lots, in Denver.

San Francisco reports that construction work for this time of the year is becoming more satisfactory every day. Large building operations which were being held up by strikes are now progressing rapidly.

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